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INTERSTATE POLLUTION OF STREAMS[1]

BY H. M. BEARDSLEY[2]

Like many another problem of existence, the pollution of drinking water supplies has progressed from the individual, through the local or neighborhood, to the interstate, national and international stage. The progression, however, seems to have been only one of quantity and area, and not one towards improvement in the principle involved, nor towards the practice of that Golden Rule which we all admit would regenerate the world and which we all say we would follow, if the other fellow would begin. For after all, what difference in principle is there between the vindictive farmer who throws a dead cat in his neighbor's well and the manufacturing plant or the city which discharges its wastes (known to be detrimental to health) into a stream which supplies other human beings with drinking water.

You may say that the filter plant can take care of all that and give us a perfectly good water. They accomplish wonders, it is true—all honor to the sanitarians who have worked out the methods and to the plant operators who carry on the work—but because we have surgeons to set broken bones, we do not break any bones if we can help it.

"Interstate Stream Pollution" as applied to Elmira means what we get from Pennsylvania through the south branch of the Chemung

[1] Presented before the New York Section meeting, January 21, 1926.

[2] General Manager, Board of Water Commissioners, Elmira, New York.

River known as the Tioga River, which has a drainage area of 1330 square miles, nearly all in Pennsylvania, and, to be perfectly fair, what we give Pennsylvania towns and cities through the discharge of our sewers into the Chemung River which flows into the Susquehanna River at Athens, Pennsylvania just over the State line.

The total Pennsylvania population on this water shed is not over 30,000 and as our own New York city of Corning, population about the same, discharges its sewage into the Chemung River only 16 miles above our intakes, I shall not attempt to charge up to interstate pollution any of our sewage troubles.

We have had, however, three distinct and, what might have been disastrous, episodes within the last 13 months which are directly chargeable to pollution from outside the state. Although I said "disastrous," I can not make a thrilling story out of this, nor set up a series of events which will tend to show how clever we are in Elmira in getting out of a bad hole. The history is just this:

On December 9, 1924, we were running along as usual, pumping raw water from the Chemung River to our filter plant. The color was 8, the raw water alkalinity was 89. The sulphate of alumina being used was 0.64 grain per gallon and chlorine 0.048. On the 10th, the color rose to 15 and the water had a distinctly dark brown or blackish color. Knowing of the existence of tanneries just over the line, we suspected tannic acid and tannery liquor. This was confirmed. The alkalinity fell to 86. The alumina and chlorine, which had been lower early in the day, were increased and we were holding our own on output. The wash water used was 4.08 per cent. The next day, the 11th, the color rose to 30, the alkalinity dropped eleven points to 75. The alumina required jumped nearly 60 per cent, the wash water 27 per cent, the output was clear, but not absolutely perfect and we were worried.

We shall take a moment here to outline supply conditions in Elmira. From 65 to 75 per cent of our raw water is pumped from the aforementioned Chemung River. The balance, or all we can possibly squeeze out of it, comes from a storage reservoir on Hoffman Creek, a creek which is absolutely dry in summer and in winter. This reservoir holds about 100,000,000 gallons and we endeavor to keep 60 or 70 m.g. in it as a reserve in case of emergency. This means that we can use very little water from it except when water is coming in during the fall rains, the January thaw or in the spring. In December, therefore, we had no surplus water to use as far as

making a regular run. It was necessary to keep up output, however, and there was nothing to do except to use enough storage water to dilute the river water to a point where it could be handled by the plant and trust that nothing would arise to force us to abandon the river supply entirely. The dilution was made about $\frac{1}{3}$ storage water and $\frac{2}{3}$ river water. The color dropped from 30 to 20, the alkalinity rose 3 points, the wash water and alumina dropped and in a day or two matters were normal again. The matter was brought to the attention of the State Board of Health which had some correspondence with the Pennsylvania Board of Health and we expected our troubles were over.

Then suddenly in the middle of the summer (1925) when the river was very low, we had a second dose, worse than the first. The color climbed rapidly up to 30 and stayed there two days, going off gradually to normal (July 11 to 16). We had little spare water in storage and did not want to use any except as a last resort, but after various attempts, on the 14th we started with a fifty-fifty supply. Because of the warmer weather, our chemical reactions were better and by using over 2 grains of alumina per gallon, washing filters twice as often as usual and running more hours, we turned out a potable, safe and clear water. (Elmira rate 150 mil. gal. per acre).

This time we did not hesitate to kick because the frequency ratio was getting too high. On July 14 I wrote to Mr. Holmquist, Director of the Bureau of Sanitation, New York State Board of Health, as follows:

> The old trouble with the Pennsylvania tanneries waste cropped up again yesterday and was so bad last night that we had to shut down our plant.
>
> I wired you this morning thinking that you might like to see actual conditions and hoping that you might be able to send a representative to look into the matter. I knew you would be interested and in view of what you told me at Louisville about the expected coöperation with the Pennsylvania Board of Health, I thought that first hand information by your Department might be very useful.

He sent me a copy of a letter from W. L. Stevenson, Chief Engineer of the Pennsylvania State Department of Health. I will read part of that letter and I want you please to notice there is coöperation there:

> Pursuant to the provisions of the New York-Pennsylvania Interstate Stream Conservation Agreement, I desire to inform you concerning the pollution of the Tioga River at Blossburg, Pa., by the discharge of contents of vats

at an abandoned tannery, because the Tioga River joins the Cowanesque River at or near the New York-Pennsylvania State Line and thence the waters thereof flow to the Chemung River in New York State.

On July 15, we received a letter reporting that it was rumored that tannery wastes had been discharged to a stream from a tannery in Blossburg and the writer said he would investigate and asked for our official complaint forms.

This morning's mail brings me a letter from our District Engineer who heard of the same matter, and on July 16 visited Blossburg, found that the tannery which had been abandoned for four years is being dismantled and cleaned, with the intention of converting it into a factory. He reports that the first evidence of tannery waste in the stream was noticed on July 8, and apparently between that date and the time of his visit practically all of the vats had been emptied into the stream, and at the time of his visit the stream had a very much higher rate of flow because of rains just previous.

This matter will be brought to the attention of the Sanitary Water Board at its next meeting and such action taken as the Board deems proper.

Mr. C. R. Cox of the New York State Health Department made his survey and made his report. He says:

It was learned that the river water on the morning of July 13, 1925, gave indication of containing much larger quantities of tannery wastes than normally and by 7:00 p.m. of the same day, the filtration plant had to be shut down because of its inability to purify the water at that time. Attempts were made during the night to start the filtration, but conditions were such that satisfactory results were not obtained until about 9:00 a.m. on July 14, at which time the filtration plant was started to treat a mixture of ½ volume river water and ½ volume of water from the impounding storage reservoir, on Hoffman Creek, which does not contain tannery wastes. The river water continued to contain larger amounts of tannery wastes than normally throughout July 14, although the concentration began to be lowered gradually until by the afternoon of July 15, the river water was practically of normal quality.

He goes on with his conclusions:

1. That the Chemung River was receiving an unusual quantity of tannery wastes on July 13, 14 and 15, 1925.

2. That this high concentration of tannery wastes was due to the emptying of vats of this material into the Tioga River from a tannery at Blossburg, Pennsylvania.

3. That the Blossburg tannery is being remodeled into a silk mill, and therefore will not contribute tannery wastes in the future.

4. That a relatively small but fairly constant quantity of tannery wastes is emptied into the Cowanesque River at Elkland, Pennsylvania, from the tanneries of the Elkland Leather Company.

5. That the Elkland Leather Company is coöperating with the State authorities of Pennsylvania in studies upon the disposal of the tannery wastes, so that the concentration of the tannery wastes in the Cowanesque River probably will be much less in the future than at present.

6. That the concentration of tannery wastes in the Chemung River on July 13, 14 and 15, 1925, was sufficient to seriously handicap the filtration plant in producing a water of a satisfactory sanitary and physical quality at the time.

7. That the Elmira filtration plant as at present constructed cannot economically purify Chemung River water when the turbidity is more than approximately 200 parts per million.

We thought then that interstate pollution was a thing of the past. In December we were having a little color in the water from tannery wastes and I wrote on December 14 to Mr. Holmquist at Albany about the matter and he referred it to the Pennsylvania Department. I should like to ask your patience while I read just one more letter from the Pennsylvania Department:

I have just received your letter of December 8 relative to difficulties in the operation of Elmira water works alleged to be caused by tannery wastes.

So far as I know, the tannery waste vats at the abandoned tannery at Blossburg, are completely empty and I, therefore, do not think that could possibly have been the cause of trouble at Elmira.

In Pennsylvania there are two tanneries on streams tributary to the Chemung River. Both of these tanneries are parties to the agreement with the Sanitary Water Board, and I am making inquiry of them to ascertain if anything unusual occurred prior to or during the period November 29 to December 4.

You will be interested to know that the work of the Tannery Waste Disposal Committee of Pennsylvania is progressing upon a thorough and scientific basis.

The more we go into it, the more difficult the problem becomes. Nevertheless, we are optimistic of the outcome, but it will take time.

Then suddenly on January 12, after I had this report outlined, the color jumped from 15 to 25. In an effort to keep up the output, the alum dosage was increased from 0.91 to 1.37 then to 1.80 and we kept running until 4 a.m. on the 13th when the plant had to be shut down. I was notified later and telegraphed Mr. Holmquist so that he might be informed as to conditions. Late in the afternoon, we were able to resume operations on a moderate rate of flow and by the next day the color had dropped to 20 and we were able to handle enough during the twenty-four hours to keep up the supply. Then came the thaw at the end of the week and we had plenty of water to use from the creek reservoir and we stopped the use of the river.

More or less briefly that is the recent history of interstate stream pollution as it relates to one type of pollution in one community. It is a real menace and Elmira is extremely grateful that she has at hand a means for counteracting the possible contagion and disease which

might follow the use of water from which the tannery waste is not eliminated. The most encouraging and forward-looking part of the whole affair is this correspondence which I have read between the two State Departments of Health. We found our own New York State Department most efficient and most ready to assist at all times. It is a great pleasure to know we have them ready to assist at all times. As I said, we are running on storage now. We do not care what the river holds, but we hope it will be cleaned up very soon.

THE INSTALLATION OF METERS IN ERIE[1]

By D. W. Harper[2]

The Erie Water Department is an unusual organization. In fact, it is unique in the State of Pennsylvania, in that it is the only Water Department in the State, instituted and still operating under a special act of the Legislature. This legislation was enacted April 4th, 1867, and under its provisions, the Commissioners were to be appointed by the Judges of the Court of Common Pleas of Erie County.

Pursuant to this Act, the Judge appointed three Commissioners and the Commission commenced to function with energy. The City Council voted a bond issue of $675,000. A contract was then let by the Water Commissioners for the construction of a pumping plant, the installation of pumps and all necessary equipment for a station with a capacity of four million gallons daily (but the first year's pumpage averaged about 182,000 gallons per day). From this modest beginning, the department has grown to its present proportions and last year pumped an average of 22,216,418 gallons per day and with many days as high as 33,000,000 gallons. There are a number of manufacturing plants, each pumping for their own use, more water than the water department pumps. It has been the constant aim of the Commissioners not only to keep pace with the growth of the city but to keep in advance of such growth, realizing the importance to the city of a well ordered water department.

With the exception that the City Council must approve the rates, rules and regulations for the sale of water, the Water Commissioners have full authority and control of the water department.

For many years the intake and pumping facilities of the Department were adequate to take care of not only their immediate demand for water, but there were also ample excess facilities to provide for the normal growth of the city. During this period, there is no record of any discussion for the sale of water, other than on the flat rate

[1] Presented before the Central States Section meeting, October 9, 1925.

[2] Water Department, Erie, Pa.

basis. However, as industrial consumers began to use water in larger quantities it became apparent that those consumers should be metered. The manufacturers assented to this as an entirely reasonable and proper method and on March 12th, 1883, a schedule of meter rates was prepared, regularly submitted to City Council and approved by them. Reference to this meter rate, as approved, is interesting, in that it was at least a gesture in the direction of conserving water by providing that meters might be attached to any premises. It reads as follows:

> Meters may be attached to any premises, where city water is used, as the Commissioners shall direct, but in no case shall the charge be less than is required by the schedule of annual rates. In all cases, where the quantity of water used, as ascertained by the meter, exceeds in value the amount to which the premises are liable by the schedule of annual rates, said excess of water will be charged for at meter rates. When more than one meter is required on any premises, the cost of each meter after the first, together with the expense of setting the same and keeping it in repair, shall be borne by the owner of the property.

For reasons which are not important to discuss, at this time, the Commissioners felt that an application of this schedule to domestic consumers would not be satisfactory and the flat fixture rates were continued. From time to time there have been modifications of the schedule above referred to, but always with the same general result.

Again there was a long period of apparent satisfaction with the sale of water on this combination schedule of flat fixture rates for domestic consumers and metering for large consumers.

About fifteen years ago, however, due to the unusual growth of the city and especially the coming to Erie of very large manufacturing plants, which were large water users, the pumping facilities and intake pipe were taxed to capacity, and it became necessary to provide for increased capacity for the intake pipe and install larger and more modern pumping equipment. In addition to this, it became necessary to extend the intake pipe out into the lake and provide settling basins, filter plant and chemical treatment of the water. These last items are for sanitary reasons. These installations taxed the revenues of the Department severely and forcibly brought to the Commissioners' attention, the importance of the conservaton of water.

From the beginning the Commissioners were cognizant of the fact that there was considerable waste of water especially on the part of

domestic consumers and a system of house to house inspection was inaugurated in an effort to reduce this waste, but with only indifferent success. This waste still continues.

From time to time they earnestly discussed the question of putting all consumers on a meter basis—not only to eliminate the waste of water referred to above, but being convinced that to sell water other than by meter was manifestly unfair—unfair in the first instance to the Department, but even more unfair to the conservative user of water.

The larger economic phase of the proposition was constantly recurring to the Commissioners, i.e., obviously, the considerable waste of water, plus the rapid growth of the city, would soon call for an additional intake pipe and a new pumping station. The estimated cost of this improvement would be not less than $2,000,000. It was equally clear to the Commissioners that this large expenditure could be deferred for a number of years, if the waste, estimated at approximately 8,000,000 gallons per day, could be eliminated and the only way in which the Commissioners felt this could be accomplished, was by the installation of meters for all consumers.

The position of the Commissioners on this question was not based on theory, but upon the experience of cities all over the country, which had already gone through the same difficulty, with which Erie was confronted.

In the year 1918, the Commissioners took up actively the question of universal metering and employed a competent corps of engineers to make a rate investigation and set up a schedule of meter rates which their investigation would indicate was fair and proper for application in Erie. This investigation was accordingly made and a meter schedule was set up. This was duly submitted to the Council and after considerable discussion failed of approval by them.

We are quite free to say that, in our opinion, the failure of the Council to approve this was due entirely to their not being in close enough touch with the serious situation in which the Water Commissioners found themselves and also that they were influenced by the quite natural fear which has been present in every city all over the country, when meters were proposed, viz.: That the installation of meters would prevent the proper use of water as well as increase the charge to the public. That these fears are groundless is readily proven by a canvas of metered cities throughout the country.

For several years after 1918, the metering question lay dormant as

far as the general public was concerned, but it was a constant subject of discussion by the Water Commissioners. It could not be otherwise, as the daily pumping reports showed that the extreme capacity of the intake pipe, was being rapidly approached. The theoretical capacity of the intake is 40,000,000 gallons per twenty four hours, but under the most favorable conditions and for periods of ten and fifteen minutes only, the best it has been able to do is 37,000,000 gallons. During the extremely hot weather as well as the severely cold spells, the pumpage has run as high as 33,000,000 gallons per day. This leaves all too close a margin and has given the Commissioners much concern. Believing that either universal metering will have to be adopted or preparations made for the providing of an additional intake pipe and a new pumping station, they again approached the City Council in 1924 with a schedule of meter rates and urged that they take early action upon this very important subject.

The Council and Mayor gave the proposed schedule earnest consideration, but frankly stated that they did not feel that they were sufficiently familiar with all the elements entering into the problem to act intelligently or hurriedly so they have employed a rate expert to investigate the whole subject and report to them on his findings. This investigation is now under way and we have reason to believe that with the honest and earnest method of approach on the part of the Council, which is now being followed up, the Commissioners will have the coöperation and support of the Council in establishing a meter schedule. It seems unnecessary in a meeting like this to take up time to prove the wisdom of universal metering, but it nevertheless seems appropriate to cite a few examples in support of the contention of the Commissioners of Water Works in the City of Erie that the very best thing for the citizens themselves is that all consumers should be metered at as early a date as possible.

For example, the City of Grand Rapids, Michigan, makes the following comparative statement of water consumption before and after metering:

YEAR	POPULATION	NUMBER OF SERVICES	METERED	AVERAGE DAILY PUMPAGE
			per cent	*gallons*
1912	120,000	21121	53	15,833,000
1922	145,947	29018	100	15,250,000

Please observe that, with an increase in population of 26,000, there was a reduction in the daily average pumpage of about 600,000 gallons per day. This is a very fair demonstration of the soundness of the argument for meters.

Again, a more recent example,—in fact, one that is now under way: The City Manager of Wheeling, West Virginia, has provided us with some very remarkable figures in the way of reduction in pumpage, due to the setting of meters before the metering process has been one-half completed:

Daily pumpage, 1922,.....21,823,000
Daily pumpage, 1925 (only 30 per cent metered).....13,600,000

A comprehensive survey of the State of Ohio has recently been made by the State Board of Health with respect to metering of water consumption. The conclusion of this report is to the effect that "for all cities and villages of Ohio, with service metered 100 per cent, the average daily consumption is ninety gallons per capita and that for cities and villages with no metered service, the average daily consumption is one hundred and seventy gallons per capita."

In passing, it is well to note that the per capita consumption in Erie for 1924 was one hundred and eighty four gallons.

The City of Chicago, after long discussion has, by a vote of two to one, authorized universal metering in that city. It was established that fully one half of the entire pumpage was being wasted and, with this fact before them, Chicago promptly decided upon metering.

We know of no city metering its water supply where the people do not use sufficient water or where, once metered, the city would consent to return to a flat rate system.

DISCUSSION

J. N. CHESTER:[3] Mr. President, the speaker was somewhat limited in his field. We have been engineers for ten or fifteen years for the Water Works Commissioners of Erie. We have also served the city. The Water Commissioners are a separate body by themselves. They are subject to action only on two questions. They can not change the rates without the Council's permission and they can not issue bonds except through the Council. Otherwise they are pretty much the czar in their own field. While we have been serving the

[3] Consulting Engineer, Pittsburgh, Pa.

Commissioners as engineers, we have also served the city as its engineers and have served two of the largest consumers of water as their engineers.

Mr. Harper told you they feared in enforcing the present meter schedule it would be unfair to the domestic consumer. That schedule is twenty cents a thousand gallon for the first twenty five and afterwards four cents a thousand gallon. Now, my way of putting that is,—I would enforce that schedule as to the domestic consumer and not let the manufacturer have water under that schedule. I would put him on a flat rate, because for a great many years this water department has not been able to deliver the water they are delivering to the manufacturers for what they have received. The domestic consumer has been carrying the burden of the factories.

When that schedule was passed, Detroit was selling water on the flat rate of two dollars and forty cents. The meters, when starting, gave it to consumers at three cents per one thousand gallons above a certain amount. Erie was charging thirty three and one-third per cent, if figuring from Detroit, more than Detroit. Today it costs Erie three and seven-tenths cents. It costs Jefferson City, Missouri, twelve cents, on operating expenses divided by consumption. The Water Works in Erie has been so prosperous that in fifteen years it has not issued a dollar's worth of bonds. It would have grown faster and better, but the burden has been carried on the wrong shoulders.

D. W. HARPER:[2] I might say, in connection with Mr. Chester's remarks, there was only one bond issue in 1867. The Department has no debts except current bills. They made all extensions and improvements under the revenue of the department. Erie is an industrial community. As to what was in the minds of the Commissioners thirty years ago, I do not know. Mr. Gensheimer has been with the department long—only forty-eight years—he may remember. There was at that time a comparatively light rate to domestic consumers. It has been reduced since. The schedule was modified once or twice. We feel that the back bone and foundation of the City of Erie are the manufacturing interests. We feel that they should be given full credit and benefit for the large pumpage for which they are responsible. We also know, as Mr. Chester suggests, that the rate of the manufacturers is too low. We had, however, a number of conferences with them. Some object, but the general proposition of

the manufacturers is that they are fair and do not want water at less than cost. The Commissioners have always taken the position that there should be a differential between the rate of the large and small consumer and on that theory I think the old rates were made up. We are now attempting to work on a scientific basis. Mr. Bankson has said repeatedly and at conferences over metering that the flat rate should be for every one. That is not what we want. It is not correct, and I am making these remarks in support of our contention, our consumers are entitled to a differential. That can be supported. They do not want anything unreasonable. That is the situation at Erie on the question. We say at the present time we have the right to meter the city. We have a right to appeal to the small user. He does not use enough water.

H. F. HUY:[4] The policy of making low water rates is conducive to waste, to careless use of water that is not required. We had a striking experience at Niagara. The power company was continuing on the low rate, having power continuous. The power company was using such water as required, in the City of Niagara, without charge. As the power company grew they commenced to waste the water and used three million gallons a day. The contract was modified and they made different arrangements with the power company. The first month they continued doing that and they got a tremendous bill on the basis of two and a half million gallons a day consumption. Water was carried through transformers, one or two inch streams flowing through the day. The rates were slightly raised. The power company immediately took steps to eliminate the transformers. If you raise the price of water to a reasonable price that you should have, look at the point of view that you will have to quit square and then let the other man see whether it pays. If it costs you more money, he will make a profit. You will find the city that has low rates has larger consumption. When the rates are higher, their consumption drops down. Niagara Falls, prior to metering, used twenty two million gallons a day. The pumpage dropped to thirteen million gallons a day after metering.

[4] President, American Water Works Association. General Manager, Western New York Water Co., Buffalo, N. Y.

L. B. HARRISON:[5] I want to mention the condition in Bay City. It has a population of about forty five thousand. Five years ago, the city was not all metered. The consumption was between seven and nine million gallons in twenty four hours, for forty five thousand population. Since the last five years we are supplying the city of Bay City with filtered water. With the city one hundred per cent metered, the consumption now is four million for forty five thousand. That is an additional fact of what metering does to the city.

D. W. HARPER:[2] An even more startling example is the fact that in Erie we furnish the water free to the schools. A few years ago Mr. Gensheimer suggested we put meters in the schools, not to charge them, but to check them up. I have not the figures at hand—Mr. Gensheimer possibly has them in mind,—but there was a criminal waste of water in many of the schools. We rendered them statements calling attention to it and suggested they put in different kind of fixtures and make every effort to reduce the waste. Yet, we have no way of enforcing the reduction of waste, if service be continued to various schools without charge. We are a unique organization and we expect and are justified in expecting all parties to the game will play fair. Now we render a statement calling attention, from time to time, to what is being used. That is reducing the waste considerably. We furnish water free to the extent of something over fifty thousand dollars a year.

[5] Water Department, Bay City, Michigan.

OFFICE ADMINISTRATION OF CITY WATER DEPARTMENT[1]

By D. C. Grobbel[2]

Administration means the conducting of the business under certain restrictions imposed by a governing body or by rules and laws made by others outside of the immediate body controlling the business. The method of administrating the office of a city water department, therefore, depends upon the will or action of others than the administration itself. Further, such administration must cover a vast variety of actions, so that it is impossible to lay down any fixed rule for the purpose of setting a guide for those who form the administration body. Under ordinary circumstances, in a water works, the administration is charged with providing detailed plans for carrying out and enforcing the rules and resolutions of the governing body, whether these rules or resolutions concern the financing of the department, the planning of new structures, increasing production or changing distribution methods. Construction work may be planned, but to the office administration comes the problem of financing these. Methods of production and distribution may be adopted, but here again the office administration must determine the rate to be charged to the consumer for the water consumed, and thereby obtain the requisite funds to operate the plant.

It will be noted that office administration delves into every corner of a water department structure. To properly provide for the administration of all the functions imposed upon an administrator in conducting the business of a city water department, he must be provided with an organization of employes, which organization, as far as the qualification of personnel is concerned, differs for the different functions to be administered, but all responsible either directly or indirectly to the administrator. Again, the details of the various functional organizations depend, not only upon the size of the municipality, the local laws or usages, but also upon the thoroughness and

[1] Presented before the Central States Section meeting, October 10, 1925.

[2] Assistant Secretary, Board of Water Commissioners, Detroit, Mich.

efficiency with which the plant is to be administered. Needless to say, a small municipality would not need as large a force for the purpose of accounting as a larger municipality, nor would a slow-growing city need the same force of engineers, superintendents and foremen in its distribution would as the faster growing municipality. In the smaller water works, the chief executive can remain in personal touch with all details of office administration. His problems of construction, production and distribution are few in number and his list of consumers is numbered by the hundred, but as the department grows and his problems of construction increase, he must transfer much of the administrative work to others. The details with which he formerly concerned himself are crowded out by the stress of more important matters. He can not longer make a personal inspection of the customer accounts, the details in the construction work under way, nor note the many small needs of improvement that are constantly present in a water works plant. He is therefore compelled to allow other hands and other minds to carry out the policies of the department, enforce its rules, attend to the details of construction, arrange the financial affairs of the department and deal with the public.

The relations of the office administration are therefore manifold, but may be roughly classified as departmental relations and public relations. Departmental relations are those that bear upon the construction, production and operation of the department. Here office administration must exercise its greatest effort to obtain efficiency and thoroughness. Construction must be planned to produce the greatest results at a minimum outlay of funds and at the same time be of such enduring character that replacements need not be made except at long intervals. Nor can the construction be of such nature that will prove unprofitable or profitable only after a long time, during which time the interest charges on the amount of money invested would for a great number of years off-set any profit that might be made.

In this connection, it must not be forgotten that it is, unless otherwise provided by law and usage, incumbent upon the office administration to provide the plans for the financing of the different construction projects. It is the office administration which determines whether the cost shall be borne through earnings of the department, or whether the department's credit shall be used for this purpose. And the office administration is frequently called upon to determine the nature of the bonds to be issued. However, whether such

financing is determined by law, either state or municipal, the office administration is frequently in position from its knowledge of the records of the department and its earning powers to assist the public authorities in their work and be a means of keeping the bonded indebtedness of the department at a minimum.

Operation is part of the departmental relation and is most important from the office administration standpoint. Any interruption of operation is certain to bring down upon the heads of the office administration the wrath of an outraged public—be the interruption ever so brief. Therefore, does the office administration make every effort to secure adequate funds and efficient labor that there may be no failure in the water supply of the municipality. Nor must these funds be spent lavishly—the office administration has its eye continuously glued to the page of records which shows the cost of each gallon or million gallons of water produced or distributed. Any deviation from what is thought to be the proper cost figure is run down and if the excessive cost is caused by negligence or inefficiency, it is the office administration that must devise the cure. If on the contrary, the costs are driven upward by the natural causes over which the operating force has no control, the office administration is compelled to provide means to meet the increase, either by providing more efficient methods of operation or adjusting the rates to provide a greater revenue.

Office administration is more obvious in its relations to the general public or the water consumer. While office administration works behind the scenes in its departmental undertakings, its work with the consumer or the general public is done in view of every one. It is to the office administration that application is made for pipe lines, services and meters. Complaints of low pressure or lack of water come to the same body. Payment for water or other charges are made to it. In fact, as far as the general public is concerned, they know very little of the department, except through their intercourse with the office administrative body. To the public the administration is the department and the administration is held responsible for all short comings that the department may have, for all mistakes that the department may make.

It is therefore necessary that the office administration must present its best side to the public. Fair in its dealings, courteous in its treatment, forebearing under abuse are necessary attributes for success in its intercourse with the public. It is, however, to be

noticed that in this intercourse with the public, the rules of the department are also to be interpreted fairly, so that neither the department nor the consumer suffers. The relation of office administration to the public is mostly concerned with the securing of a proper return for the service rendered by the department and it is well for the office administration to bear in mind the viewpoint of the consumer when making any adjustment of the rate structure. Although the department may have a monopoly of the service in a particular municipality, it certainly does not follow that the charges be based upon this monopoly but rather upon a fair estimate of the needs of the department for operation and maintenance, sinking fund, interest and a fair allowance for the ordinary betterments.

Bearing the above in mind, the department will be able to sell itself to the public and again, although the department may have the monopoly in the community, it still needs to make friends of the consumer and the public. This friendship is necessary for the purpose of financing the department by bond issues, for the purpose of creating a favorable attitude among the citizens and the officers of the community and for the purpose of placing the intercourse between the consumer and the office administration on an amicable basis.

No specific methods of office administration have been presented, since its activities, to a very great extent, depend upon the laws and usages of the different municipalities or localities. Moreover, office administration changes more frequently in its attitude toward historic rules than any other division of a water department. In doing so, the office administration is following, or possibly at times, anticipating the public mind—where once the operation of a water department by a municipality was deemed revolutionary and looked upon as an enterprise to be conducted by private capital, now this same operation is considered a municipal governmental function, similar to such other functions as the fire department, the tax assessors or the police. Again, the rapid development of cities and their suburbs in recent years, and the attendant enlargement of the commercial and industrial life have made it necessary for the office administration to plan many additions for the department—change its method of accounting and billing, its plan of rates and financing.

This is more evident in the larger cities, as may be witnessed in Detroit—where in the past five years, it has been necessary to construct nine hundred and ten miles of pipe and change its method of making assessments for this pipe, three times. New ways of handling

suburban pipe extension had to be developed, and additional costs of production in the shape of filtering the water had to be absorbed. A new rate was established, changing from the minimum with a flat rate to a modern three-step rate and service charge. Payments which had heretofore only been made at the Main Office were arranged to be made at branch banks without cost to the department or the consumer. Where the department had only made a service tap, it now lays the service to the lot line and the day is not far distant when this service will be brought into the building.

All of the above changes were made without dislocating any operations of the department. However, the work of the office administration is not by any means finished, for, but a few days ago, a new meter reading and customer accounting system was adopted, by which it is hoped to give better service to the consumer and reduce the cost of the department.

As quite a number of the members of the Central States Section are familiar with the present Detroit system of three meter reading districts and its methods of billing and collecting, it might be interesting to them to know that under the new scheme there will be thirty six reading districts and every other day in the month will be a final payment day. Further, the new scheme will bring the reading date within seven days of the bill delivery date, instead of an average of six weeks, as heretofore.

Incidental to the above, the scheme provides a method of internal audit of receipts, a better control on delinquents and a larger output of bills at a less cost, per account, the latter no small item when it is realized that Detroit has approximately 202,000 meters in service.

As previously stated, no specific methods of office administration have been presented in this paper. However, it is hoped that this paper might provoke a discussion of office administration action as practiced by water departments in the Central States. Such discussion should prove not only interesting but also highly instructive.

DISCUSSION

J. N. CHESTER:[3] You contemplate carrying your service pipes into the building. Carrying it back fifty feet from the street, who will own the service after it crosses the property line?

[3] Consulting Engineer, Pittsburgh, Pa.

D. C. GROBBEL:[2] That is a good question, Mr. Chester. I think that will be determined by the charter of the City of Detroit.

J. N. CHESTER:[3] The charter cannot change the land laws. Anything on the real estate goes with the real estate.

D. C. GROBBEL:[2] Not necessarily so. We are not handling the service with capital. We charge a man forty dollars to lay a pipe from the main. We make the ditch and lay the pipe on the ordinary street. We do not charge for the lead or for the ditch, but for the permit to put that in. However, the question is, should it belong to our capital investment? The Courts will unquestionably say it is a capital investment.

J. N. CHESTER:[3] The other courts did not sustain that.

H. F. HUY:[4] In answer to Mr. Chester's question—we have a number of pipe lines owned by the water company on private property. Previous to that we made a contract that they are attached to the realty of the property and the water company has the right to remove the same. Another feature provides for all meters on private property at all times. When a house is sold, that is covered again, when the contract is originally entered into. You could cover that situation if you chose to lay pipes on private property.

J. N. CHESTER:[3] What value is that service to the water company, even though it has the right to remove it?

H. F. HUY:[4] As a part of business production—revenue to your property.

J. N. CHESTER:[3] Take the situation where you will. In the case of mains across private property, if you have an agreement that the pipe is yours, you have an easement across the place. If you file your agreement at the Court House you put an encumbrance on that man's property. This is all right and we advise our clients to do so. We do it ourselves, where we are the owners. We will not lay an inch of pipe on property unless it is recorded at the Court House.

[4] President, American Water Works Association. General Manager, Western New York Water Co., Buffalo, N. Y.

H. F. HUY:[4] It is a question of law whether it is necessary to record an easement. If the physical evidence is there, is it of use? In other words, you can not claim an exemption that a man has no right because you did not have it on record. If it is physically observed that it is there, that is just as good as putting it in the Court House.

J. N. CHESTER:[3] When a man comes and buys a house and lot, the seller of the property is not going to say: "There is an easement on here" if he can help it. It is under ground and he can not see it. If he buys it, everything is in. The meter is in evidence. Take the laws of the State of Pennsylvania, they would say that the meter is the company's, but not that the service pipe or the main is the property of the company.

H. F. HUY:[4] The evidence is that that pipe is in the ground. He sees the evidence of the pipe line.

D. C. GROBBEL:[2] In case the local laws provide that the water department shall still be the owners of pipe lines, service, etc. it belongs to the water department.

J. N. CHESTER:[3] No sir, the local laws can not over-ride the government land laws.

D. C. GROBBEL:[2] You will find in Michigan the water department generally owns the pipe under the local laws. I do not believe, as far as Michigan is concerned, it would be affected.

A MEMBER: If there is a man living on the north side of the street does that property pay as much for service as the man on the south side of the street, if the first has ten feet of service and pays $40, while the other has sixty feet?

J. N. CHESTER:[3] In the City of Pittsburgh we pay for everything that goes to the curb line or inside. The laws of the State of Pennsylvania are that the city makes the consumer pay for everything they do, unless the Public Service Commission says, when it is owned by a private company, that they must make the tap, pay for the permit, carry it in the curb line and own and maintain it. We have certain

small municipalities and they sell water for so much and do so and so. They do not think how much the department exacts from that consumer before furnishing him, how much of the capital charge is paid by the consumer.

A MEMBER FROM WARREN, OHIO: In our city the owner pays for all service and that includes tapping. The city taps and is paid $2.50 for that. The service in that connection belongs to the property owner and is controlled by the city. Lately they passed an ordinance requiring their leading pipe on to properties, piping all the way in to the meter. The original contract under the old water company, before the city took away the plant franchise, was that all service should be led to the curb. In later years we found there was much steel pipe put in between the curb and the meter and there was so much leakage that they passed this new ordinance and they lead the pipe in to the meter. There is another condition along the line in which we are speaking. When the city took hold of the plant on January 1, 1921, they bought from the local company their own water department. At that time all of the water pipes in the street did not belong to them. During a few years preceding that time, a great many property owners laid cast iron pipes in the street. This the city did not buy and the company had no right to sell. They are confronted with a difficulty with these real estate owners. They come to us and want us to purchase the pipe in the street. To whom does the pipe in the street belong?

ADDITIONS TO THE EVANSTON, ILLINOIS FILTER PLANT[1]

By Paul Hansen[2]

The prevalence of typhoid fever in Evanston prior to 1913, the fact that adequate treatment of the water supply with hypochlorite of lime for sterilization imparted an objectionable taste to the water, and the fact that the water supply at times was highly turbid, led to the installation of a filter plant in 1913 and 1914 as the only rational and economical solution of the local water works problem.

The original plant was designed by George W. Fuller and Langdon Pearse, and was installed under their direction. The plant and its construction were described in The Journal of the American Water Works Association for 1915 by Mr. Pearse.

The original plant had a nominal capacity of 12,000,000 gallons per twenty-four hours and comprised the following elements:

(1) Chemical preparation and feed devices, including means for the application of alum and hypochlorite of lime. Liquid chlorine and apparatus for its application was later installed.
(2) A mixing and reaction chamber with a nominal retention period of twenty minutes.
(3) Two coagulating basins with a total nominal retention period of one hour and forty minutes.
(4) Six mechanical filter units, each with a nominal capacity of 2,000,000 gallons.
(5) A covered clear water storage reservoir with a capacity of approximately 2,000,000 gallons.

At one end of the group of filters is a head house for chemical preparation and feed devices, chemical storage, laboratories, offices, toilets and lockers. This same head house is adequate for serving the enlarged plant.

The arrangement of the original plant was somewhat unusual, as a result primarily of limited land available and certain restriction with reference to architectural effects to harmonize with the buildings

[1] Presented before the joint sessions of the Illinois, Wisconsin and Iowa Sections, March 17, 1925.

[2] Of Pearse, Greeley & Hansen, Consulting Engineers, Chicago, Illinois.

of the Northwestern University. These restrictions were imposed on account of the fact that the land was acquired from the Northwestern University. At the time the original plant was installed the importance of a design that would permit of ready expansion was fully appreciated and the arrangement adopted was such as to permit of a maximum utilization of the land available, in connection with the construction of future additions.

In designing the original plant there was recognition of a tendency to large and variable consumption and the capacity adopted was deemed adequate to meet requirements until at least 1930. Notwithstanding the foresight with which the plant was designed, the consumption of water in Evanston increased much more rapidly than anticipated. Even the metering of all services failed to cut down the consumption materially. This is explained by the fact that most of the residents of Evanston have more or less extensive lawns and have sufficient means to use all of the water they desire. This condition is reflected in the range of consumption shown in table 1, and also by the fact that the largest consumption occurs on warm dry days in summer.

The design of the original plant was very carefully worked out and the best commentary on this is the fact that it was not necessary to change any essential detail in designing the new additions. The new filters units are all precisely like the old ones.

In this connection it is interesting to note that bids were taken on a pipe underdrain system and a concrete underdrain system with brass strainer plates of a design exactly like the old ones. Contrary to expectations a lower price was obtained on the concrete system than on the pipe system. The concrete system was also preferred by the the water works management, although there had been considerable trouble after the installation of the original system due to breakage of bronze bolts for holding down the strainer plates. This difficulty was found to be due to imperfections in the metal and was completely overcome by substituting monel metal for bronze.

The only important modification made in the new work was the use of reinforced concrete slab construction in the place of groined arch construction for the coverings over the clear water reservoir and the coagulating basins. Even this change was not essential, but was deemed advisable on account of the greater familiarity of contractors with the slab construction and the assurance of obtaining better prices.

The new additions permitted some readjustments to facilitate operation, principal among which was the shortening of the coagulant feed line to the reaction chamber and coagulating basins, the rearrangement of the reaction chamber and coagulating basins so as to permit their complete control from the end of the basins immediately adjoining the filter operating room and the substitution of sluice gates for stop planks throughout.

The nominal capacity of the enlarged plant is 24,000,000 gallons, or double the capacity of the old plant. For periods of a few days the filters may operate at the rate of 36,000,000 gallons per twenty-four hours. If the rate of consumption were uniform this quantity could actually be delivered to the consumers, but the rate of consumption is not uniform, and, therefore, clear water storage is necessary to neutralize the hourly fluctuations and to provide a certain reserve for washing the filters and a further reserve for meeting fire emergency. The limitation of land did not permit obtaining as much clear water storage as would be desirable. In fact, it was only possible to increase the clear water storage by 667,000 gallons making a total of 2,667,000 gallons, whereas eight to nine million gallons would have been desirable.

It became of interest, therefore, to determine what actual maximum daily consumption the new filter plant can meet. Accordingly a curve was plotted, shown in figure 1, which represents the composite hourly fluctuations in consumption of a number of typical days of large consumption. If the filters are operated at the maximum rate consistent with preventing the overflow of the filtered water reservoir, we estimate that, with the available clear water storage, the maximum actual yield of the filter plant in a single day is about 31,000,000 gallons.

To indicate how long the plant will fulfill the requirements of the cities of Evanston and Wilmette, we have studied the probable future water consumption. Figure 2 shows the probable future population growth of Evanston and Wilmette. We have indicated both a maximum and a minimum. For estimates we have used a mean rate. The consumption records of the plant were carefully examined with the result that the per capita consumptions given in table 1 may be regarded as applicable to the future.

Combining these per capita figures with population figures for the various years there was developed figure 3 giving the total average daily consumption for the maximum month, maximum day and

maximum hour for various years. In the operation of the filter plant the maximum day will be the controlling factor. As already indicated the maximum actual daily output of the filter plant will

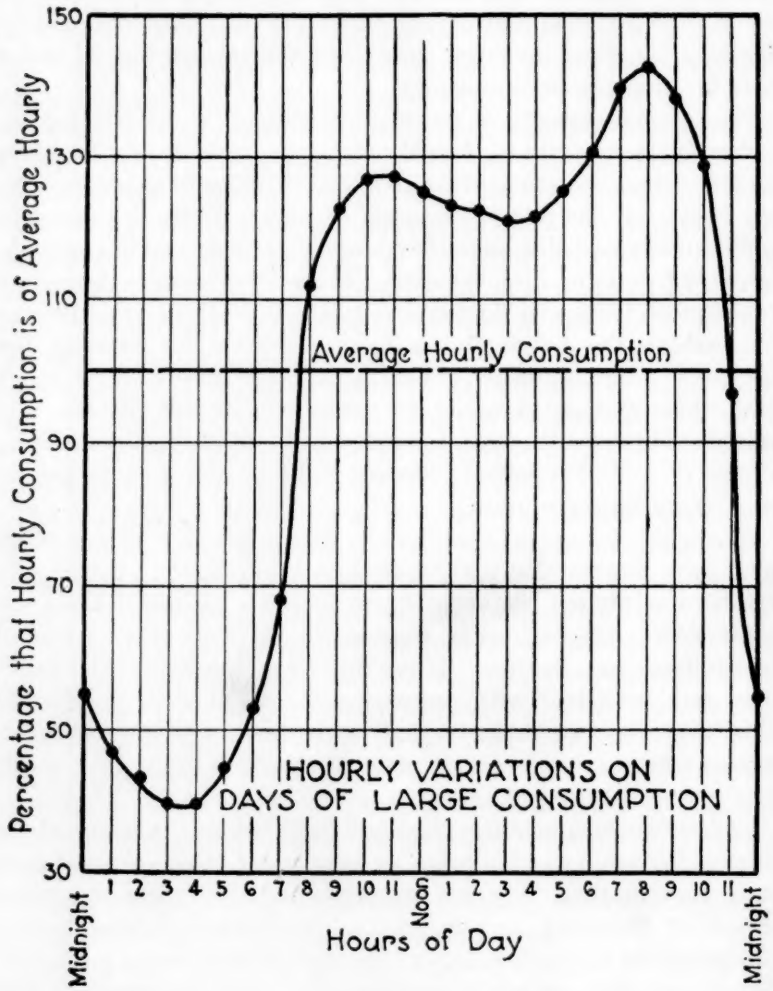

FIG. 1

be in the neighborhood of 31,000,000 gallons. This capacity, according to our estimates, should prove adequate until the year 1952 when the population of Evanston and Wilmette will be very close to 109,000.

The plant is very flexible and easy to control. The coagulating basins may be used in series, in parallel, together or independently, with or without the reaction chamber. The filters have all been equipped with new rate controllers of an improved type devised and

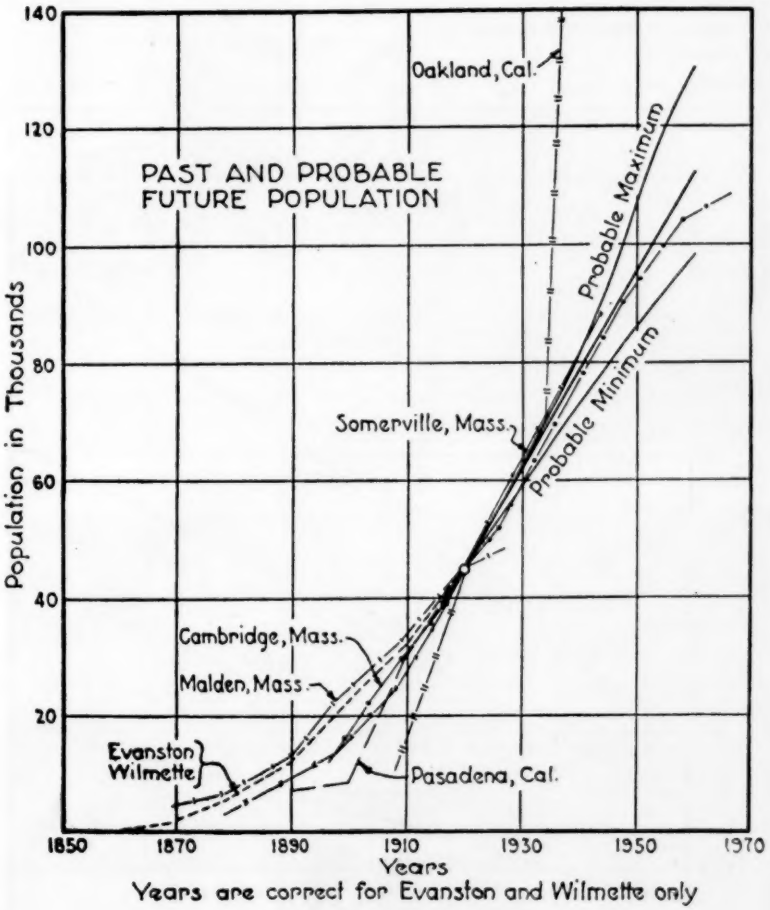

FIG. 2

manufactured by the Builders Iron Foundry. The various connections to the filters are controlled by hydraulically operated valves, operated by hand-levers on operating stands, which stands are placed on the operating floor in front of each filter. The flow of water to the filter plant from the low-lift pumps is measured by a

TABLE 1

Per capita consumptions used as basis of design for new additions

CONDITION	GALLONS PER CAPITA PER DAY
Average per year	160
Average per maximum month	240
Maximum day	320
Maximum hour	430

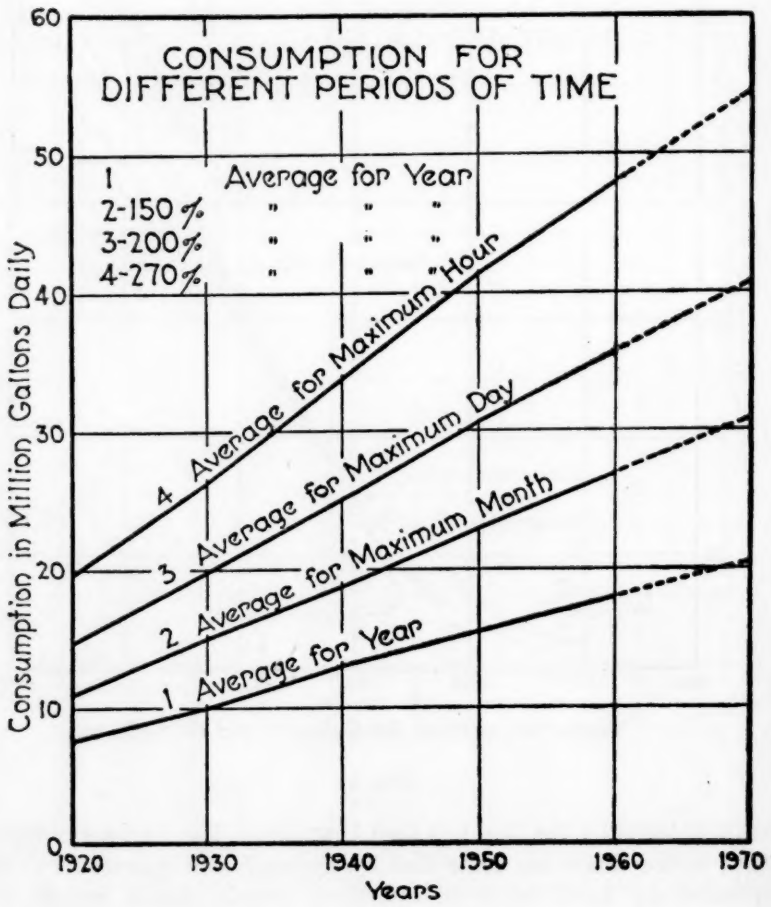

FIG. 3

FIG. 4. EXTERIOR OF EVANSTON FILTER PLANT

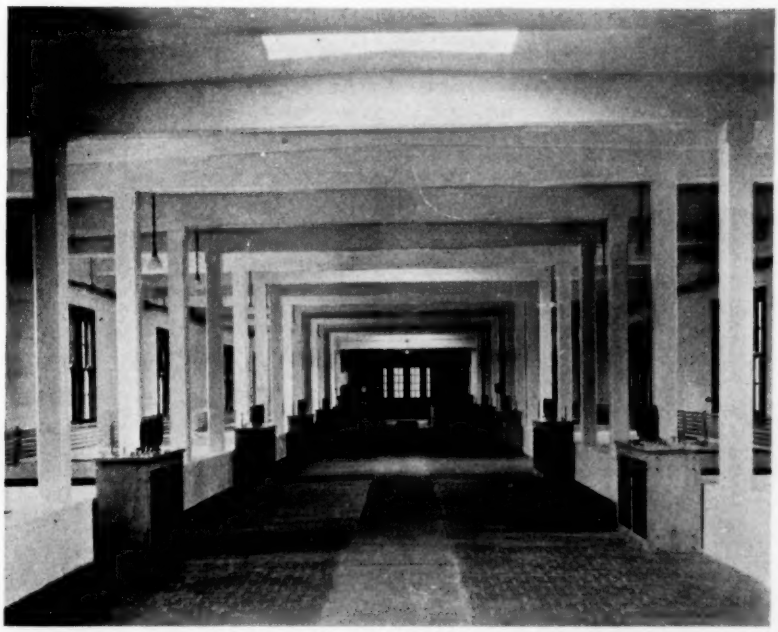

FIG. 5. OPERATING ROOM, EVANSTON FILTER PLANT

Venturi meter, and the discharge into the distribution system is also measured by a Venturi meter.

The high-lift pumping equipment has been augmented by a new Allis-Chalmers cross compound crank and fly-wheel condensing pumping engine with nominal capacity of 18,000,000 gallons per twenty-four hours. Some interesting problems of underpinning and construction had to be worked out in connection with the preparation of suitable space for this new pump in the existing pumping station

The actual structural details of the filter plant involve nothing exceptionally new or novel. In exposing the walls which receive the thrust of the groined arches of the old plant, special care had to be observed to remove water pressure and to provide for a construction which would resist the tendency of these walls to be pushed out by the pressure of water and the thrust of the arches.

The general appearance of the exterior of the plant is shown in figure 4 and a view of the enlarged operating room is given in figure 5.

The additions to the filter plant were designed by and built under the supervision of Pearse, Greeley and Hansen. H. D. White was Resident Engineer. The general contractor was W. J. Newman Company of Chicago, and the filter contractor was the Norwood Engineering Company of Florence, Mass. W. S. Blanchard was Commissioner of Public Works of Evanston and had general responsibility for the improvement. G. A. Wadsworth, Superintendent of Water and W. N. Wood, Superintendent of Filtration, were closely in touch with the work and offered many helpful practical suggestions in connection with the design.

PLACARDING PUBLIC WATER SUPPLIES ALONG TOURIST HIGHWAYS[1]

By Earle L. Waterman[2]

During the past summer a new sign has greeted the travelers along Michigan highways. It carries a word of warning concerning one of the most dangerous perils of the road. It warns the traveler against the use of unsafe drinking water. The sign is 14 by 27 inches and the black lettering on a gray background reads "Caution —Drink only Water Approved by the Michigan Department of Health." These signs are conspicuously posted at five mile intervals along the trunk highways.

Another type of sign is to be placed along the highways in Minnesota which will indicate to the tourist or other traveler that the public water supply of the town about to be entered is safe. This sign, 18 by 24 inches in size, will announce in deep blue letters on a yellow background—"Public Water Supply Approved by the Minnesota State Board of Health." The signs will be placed on state trunk highways by the State Highway Commission and on the county roads by the county engineers. Permission to erect such signs is given only under certain conditions which must be agreed to by the municipality. Briefly the municipality must agree to have its water supply investigated at least once a year and to make such changes, improvements or repairs to the water supply system from time to time as may be necessary to maintain it in a satisfactory condition. They agree to notify the State Board of Health promptly of an accident which might affect the sanitary quality of the water and also to offer no objection to the removal of the signs in case the water supply at any time is found to be below the standard of purity required by the State Board of Health.

This project of placarding public water supplies along tourist highways is a further development in the plan of marking sources of safe drinking water along these highways. The plan was origi-

[1] Presented before the Iowa Section meeting, December 4, 1925.

[2] Professor of Sanitary Engineering, University of Iowa, Iowa City, Iowa.

nated by the Ohio State Department of Health about two years ago and has been very carefully worked out in that state. It is an attempt to answer the question of the motorist—"Where may safe drinking water be obtained along the public highways?" The construction of hundreds of miles of improved roads and the use of these roads by many thousands of motorists has made this question of safe drinking water along the highways a very important one from a public health standpoint. Most municipal water supplies have been developed and are maintained so that they meet the standards set up by the state departments of health.

The resident of a city which has a satisfactory public water supply has acquired a feeling of safety concerning the water which is furnished to him in his home and in fact pays very little attention to it. He knows that the whole matter of water supply is in the hands of competent men and that the quality is carefully watched by local and state health officials. Under these circumstances it is not strange that the average citizen has no experience and no knowledge which will enable him to judge whether or not the waters which he finds along the highways in the open country are safe to drink. The use of water in his home has perhaps led him to believe that any water that is clear, cool and pleasant to the taste is a safe drinking water and he drinks such waters wherever he can find them.

The problem then is to designate by definite, descriptive placards those sources of semi-public water supplies along the highways which are safe. The general plan is to make a sanitary survey of each source of supply along the road. If the survey shows that the supply is properly located, properly developed, and properly maintained then samples of water are taken for laboratory examination. The results of this examination are considered with the report of the sanitary survey and a decision made as to whether the source of supply will furnish a safe drinking water. If the data indicate that the supply is satisfactory the owner of the property on which the supply is located is asked to sign an agreement with the state department of health permitting the placing of signs and agreeing not to object to the removal of such signs whenever the state department finds that the supply is no longer safe. Usually a small sign is attached to the pump or faucet and a larger sign erected in front of the property and others a few hundred feet from it along the highway on either side. This plan of marking enables the motorist to find the supplies of safe drinking water without difficulty.

Definite programs for marking the safe sources of water supply along the principal highways are being carried out in Connecticut, Delaware, Indiana, Illinois, Kentucky, Michigan, Minnesota, Missouri, Ohio, Pennsylvania, and Washington. Sanitary surveys and bacteriological examinations of roadside water supplies are being made in Arizona, Maine, New Mexico, Rhode Island and Virginia, but no signs have been erected in these states. The water supplies at tourist camps are supervised by the state health departments in Maryland, Texas and Utah. This summary indicates that the problem is receiving attention in many states and it seems probable that it will eventually be recognized as an essential phase of state sanitary engineering throughout the United States.

The work on highway water supplies in Pennsylvania is unique in one respect. The laboratory examination of samples is made in a field water laboratory. Specially designed bodies are mounted on truck chassis. The car is equipped with all the apparatus necessary for a complete bacteriological examination. Samples are collected during the day and the examination started within six hours of the time that the sample was taken. In addition to the routine roadside samples it is the practice in Pennsylvania to take at least two samples from the public supply of each municipality through which the field laboratory passes. The use of a field laboratory eliminates the uncertainties in results which arise when samples have to be shipped some distance to a central laboratory. The experience with a field water laboratory during the summer of 1924 was so satisfactory that two units were used in the work during the summer of 1925. During the last season these units covered 2700 miles of highways and 2360 supplies were examined. This figure includes re-examination on 410 supplies which were approved in 1924.

Minnesota is the first state to undertake the posting of safe public water supplies, although Pennsylvania makes the same examinations of this type of supplies as are made on the semi-public highway supplies. The use of "Caution" sign warning travelers in Michigan to drink only water approved by the state department of health seems to indicate that signs will soon be used in that state to mark the locations of approved public water supplies.

The placarding of safe public water supplies along tourist highways has several features which commend it. First, it will inform the travelling public of the location of approved water supplies;

second, it will advertise the municipality as one which is furnishing a safe water within its boundaries; third, it will be an incentive to laggard public officials to see to it that their public water supply is up to required standards. It is a project which may well receive the hearty support of all water-works men.

SEASONAL VARIATIONS IN THE AMMONIA AND NITRATE CONTENT OF LAKE WATERS[1]

By B. P. Domogalla,[2] E. B. Fred and[3] W. H. Peterson[3]

In a previous paper (1) the marked seasonal variation of the ammonia and nitrate content of lake waters was reported. During the winter it was found that the lower strata show a decided increase in the free ammonia and in the nitrate nitrogen. This is followed in midsummer and in early fall by a disappearance of the nitrates and another rise in the ammonia content. The experiments recorded here were undertaken with the view of studying the possible factors which cause these well defined changes in the forms of nitrogen in lake water. The preliminary data indicated that these fluctuations are due to the seasonal variations in the activity of certain groups of microörganisms.

That ammonia and nitrate formation as well as nitrate reduction in fresh and salt waters are the result of the activity of certain bacteria has been pointed out by various investigators. Thomsen (2) found nitrifying bacteria with morphology very much like those found in soils active in sea water near Kiel at temperatures that ranged from 1 to 55°C. Russell, Jones, and Bahrt (3) found nitrifying bacteria in Nebraska soils having the same range of activity as those found in sea water, from 5 to 55°C., with their maximum at 35°C. Lipman (4) reported the absence of nitrification in sea water. Minder (5) in a study of the bacterial flora of different lakes noticed that the ammonia content of waters was proportional to the bacterial count while the nitrate content was just the reverse. Drew (6) found denitrifying bacterial flora in the tropical ocean waters which he believed caused the precipitation of calcium carbonate. Kellerman and Smith (7) as well as Lipman (8) noticed that denitrification takes place in

[1] This work was supported by the special research fund of the University of Wisconsin and by the Engineering Department of the City of Madison, Wisconsin.

[2] The Wisconsin Geological and Natural History Survey and the Engineering Department of the City of Madison, Wisconsin.

[3] The University of Wisconsin, Madison, Wisconsin.

ocean waters. Smith (9) in a further study of the bacteria of ocean waters and mud found a large number of ammonifiers present. Netschaff (10) noticed a seasonal variation in the denitrification activity in the Newa River in Russia. The process was found to be active in spring and fall, and at a temperature as low as 0°C.

EXPERIMENTAL

Lakes studied. Seven inland lakes of Wisconsin and Lake Michigan have been included in this study. A brief description of these lakes has been given in an earlier report (11). A more detailed description of the Wisconsin lakes and their plant and animal life has been given in reports of the Wisconsin Geological and Natural History Survey (12).

Lake Mendota and Lake Monona were studied more closely than the other lakes. Lake Mendota is 6 miles long, 4 miles wide, and has a maximum depth of 84 feet. Lake Monona is 4 miles long, 2½ miles wide, and has a maximum depth of 74 feet. Both lakes are hard water lakes and contain an abundant growth of plankton. Due to their depth these lakes become thermally stratified. From late June to early October the water is separated into three distinct strata. The upper layer is warm and kept in circulation by the wind. It is in this upper layer that the majority of the plankton organisms are found. The bottom layer consists of cool water which has little or no circulation. It is here that the greatest proportion of the decomposition of the organic matter takes place together with a depletion of oxygen. Between these two strata there is a transition zone in which the conditions change from those of the warm water above to the cool water below.

Samples. Two to 5 liter surface, bottom, and mud samples were taken from all of the lakes studied. The bottom samples in each case were taken about 2 meters above the mud. In the case of Lake Mendota and Lake Monona 5, 10, 15, and 20-meter depth samples were taken in the middle of the lake at times when these lakes were well stratified. Samples were taken each week or more frequently when marked changes in the chemical or bacteriological activity was noticed. The dissolved oxygen samples were collected in special 250 cc. bottles. The bacteriological samples were collected at the same time in large sterilized Pyrex test tubes by the use of a special sampler (13). The tables in this report indicate the average analyses for each month.

TABLE 1

Bacteriological and chemical analysis of the waters of Lake Mendota

DATE	DEPTH	BACTERIA PER CUBIC CENTIMETER*	NITRATE REDUCTION IN DAYS		NH_3–N	NO_3–N	NITRIFICATION IN DAYS		DISSOLVED OXYGEN
			11°C.	28°C.			11°C.	28°C.	
1923	*meters*				*mgm. per cu. M.*	*mgm. per cu. M.*			*grams per cu. M.*
July 24	1	800		7	96	23			
	20	1600		3	420	40			
1924									
March 12	1	1300			180	11		36	13.2
	20	1800			748	60		27	5.3
April 7	1	2300		20	144	83		25	13.1
	20	2300		20	144	83		25	4.2
July	1	1500	20	18	73	25		33	8.9
	20	1700	13	10	392	53		38	1.5
October	1	2500	10	8	66	15	42	39	8.8
	20	2000	8	6	640	16			0.3
November	1	1900	12	11	110	14	37	34	9.1
	20	2000	12	11	112	15	37	34	9.1
December	1	2200	25	21	120	16	34	32	9.2
1925									
January	1	2600	24	22	128	17.3	37	33	13.24
	20	2850	21	20	160	19.7	27	24	7.66
February	1	3800	23	20	142	24.0	36	32	12.73
	20	2300	17	15	324	47.4	28	22	6.04
March	1	1200	19	16	147	62.7	32	29	12.15
	20	1600	12	15	556	121.2	18	14	3.51
April	1	1300	19	16	190	70.3	25	20	9.29
	20	1300	19	16	192	72.3	25	20	9.30
May	1	1100	15	13	184	61.0	24	19	10.61
	20	1000	10	8	211	74.5	25	19	9.45
June	1	1500	13	11	173	45.6	26	22	7.95
	20	1300	9	6	285	68.7	28	23	4.58

TABLE 1—*Continued*

DATE	DEPTH	BACTERIA PER CUBIC CENTIMETER	NITRATE REDUCTION IN DAYS		NH_3–N	NO_3–N	NITRIFICATION IN DAYS		DISSOLVED OXYGEN
			11°C.	28°C.			11°C.	28°C.	
1925	*meters*				*mgm. per cu. M.*	*mgm. per cu. M.*			*grams per cu. M.*
July	1	2000	12	8	72	18.0	32	27	8.10
	20	2500	8	5	460	32.0	34	31	0.0
August	1	1800	10	7	73	19.5	33	28	8.30
	20	2300	7	5	568	21.0	37	33	0.0
September	1	1400	15	12	84	19.0	28	24	7.60
	20	1900	9	8	697	12.5	33	28	0.00
October	turn-over	2200	15	14	240	12.0	25	23	8.83
November	1	2100	15	15	188	17.9	26	23	9.05
	20	2500	18	16	210	18.4	29	25	8.98

* Bacteria grown on Nutrose Agar at 28°C.

Methods of analysis. The different forms of nitrogen were determined on fresh water according to the procedures given by the American Public Health Association (14). The dissolved oxygen samples were collected in special bottles and analyzed according to the Winkler method as given in the Wisconsin Survey Bulletin (15).

The total number of bacteria present in lake water was determined by plate counts, on Nutrose agar and beef peptone agar. The rate of nitrate reduction was measured by the number of days required to completely destroy the nitrates in 10 cc. of Giltay's solution containing 0.01 per cent KNO_3. The rate of nitrification was measured by the time required to oxidize to nitrates the ammonia in 50 cc. of 0.1 per cent $(NH_4)_2SO_4$ medium after inoculating with 50 cc. of water.

DISCUSSION OF RESULTS

1. Chemical and bacteriological variations in the waters of Lake Mendota

The forms of nitrogen listed in table 1 and figures 1 and 2 are the main sources of supply for the plankton, and other forms of life in the lake waters. The chief sources of this nitrogen are from inflowing

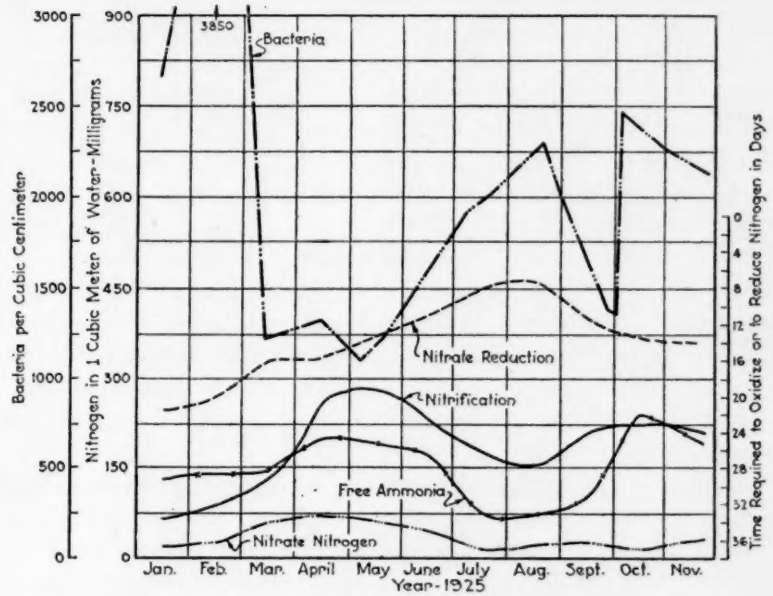

FIG. 1. NUMBER AND ACTIVITY OF CERTAIN GROUPS OF BACTERIA AND THE AMMONIA AND NITRATE CONTENT OF THE SURFACE WATERS OF LAKE MENDOTA IN 1925

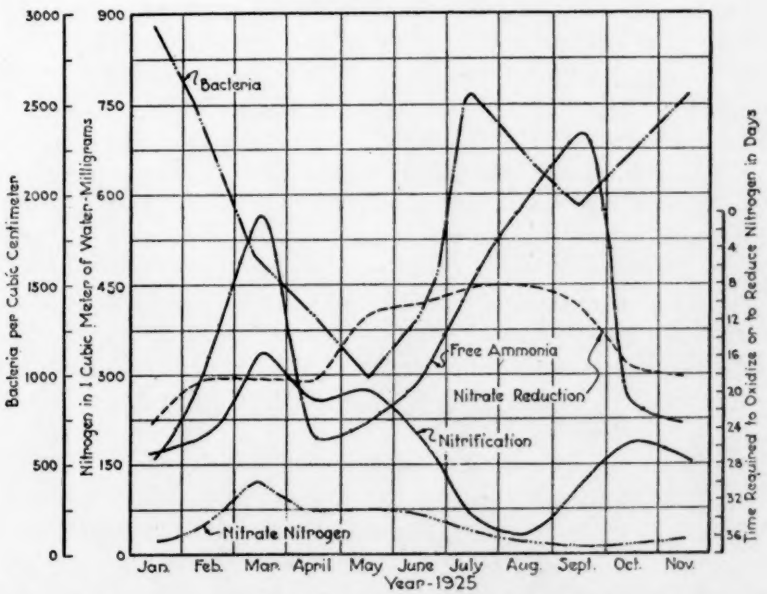
Bacteria
Free Ammonia
Nitrate Reduction
Nitrification
Nitrate Nitrogen
Bacteria per Cubic Centimeter
Nitrogen in 1 Cubic Meter of Water-Milligrams
Time Required to Oxidize or to Reduce Nitrogen in Days
Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov.
Year-1925

FIG. 2. NUMBER AND ACTIVITY OF CERTAIN GROUPS OF BACTERIA AND THE AMMONIA AND NITRATE CONTENT OF THE BOTTOM WATERS OF LAKE MENDOTA IN 1925

waters, rain, and decomposition of organic material contained in the mud and debris at the bottom of the lake. Besides free ammonia various forms of soluble organic nitrogen are formed from the decomposition of the bottom debris as mentioned in a previous paper (16). Most of the debris in the lake settles out along the bottom about a block away from the shore, and covers an area from the 10-meter zone to the 23-meter zone. The debris gradually changes to a loose black mud with about 85 per cent moisture content. In December before the decomposition becomes very active the total nitrogen in the mud averages about 0.11 per cent on the dry basis: in other words there is about 680,000 kgm. of potential nitrogen in the 620,000,000 kgm. of mud. The analyses of the lake waters show that but a small portion of this nitrogen tied up in this mud is changed into soluble forms of nitrogen.

As soon as the soluble nitrogen increases in the bottom strata it begins to spread upward toward the surface. The marked changes appear first and are more pronounced in the lower layer than in the surface water. During the spring and fall turnovers, the soluble nitrogen content is uniform. As soon as stratification begins, these forms of nitrogen in the bottom strata again exceed those in the surface water. An understanding of these changes can be better gained by considering the variations which occur in the bottom water of Lake Mendota.

Beginning with the fall turnover there is little change in the soluble nitrogen until mid-winter. Sudden and enormous increases occur in February and March. By the time the spring turnover occurs in April a total increase of about 300 per cent in free ammonia and about 200 per cent in nitrate nitrogen are observed in the bottom strata. The increases are observed first in the bottom water and later at various depths until finally they are noticed at the surface. During the time that the ammonia and nitrates increase the oxygen decreases in the lower strata, but does not disappear entirely, as is the case during the summer months. Sufficient oxygen is present during the winter months for the oxidation of ammonia to nitrates.

In spring after the turnover takes place the lake becomes uniform throughout and the bottom and surface samples contain the same quantity of ammonia, nitrates, and oxygen. When stratification again takes place in early summer, the nitrates decrease and the ammonia again increases in the lower layer of water. In midsummer the oxygen also disappears rapidly from the bottom and the

reduction of nitrates is most active. The analyses of the lake waters for the last four years have shown that the increase in the ammonia content in the bottom waters during the winter months reaches a higher concentration than during the midsummer stratification. In 1925, however, the ammonia content in the lower strata did not rise to as high a level in winter as in former years due to the fact that the time for the winter stratification was about a month shorter than the average.

At a time when the soluble forms of nitrogen were high in Mendota, samples were collected from various places and depths of the lake,

TABLE 2

The distribution of ammonia and nitrate nitrogen in Lake Mendota water
Calculated for 1 cubic meter of water

STATION	SURFACE			10 METRES			18–20 METERS		
	2/1/24	3/3/24	3/11/25	2/1/24	3/3/24	3/11/25	2/1/24	3/3/24	3/11/25
Ammonia nitrogen									
	mgm.	*mgm.*	*mgm.*	*mgm.*	*mgm.*	*mgm.*	*mgm.*	*mgm.*	*mgm.*
I	104.0	180.0	152.0	120.0	204.0	196.0	176.0	392.0	472.0
II	120.0	196.0	164.0	128.0	216.0	280.0	200.0	640.0	544.0
III	120.0	193.0	180.0	144.0	236.0	236.0	208.0	528.0	528.0
IV	104.0	176.0	160.0	112.0	200.0	212.0	168.0	384.0	500.0
Nitrate nitrogen									
I	27.8	62.5	55.5	55.5	76.9	65.7	68.9	119.0	96.2
II	31.2	87.9	55.8	61.7	90.9	73.5	78.4	178.5	125.0
III	34.8	78.1	67.0	63.3	87.7	70.4	87.0	166.6	111.1
IV	29.7	66.6	61.6	58.8	96.1	68.5	80.0	125.0	104.2

table 2, as well as from the inflowing springs. The forms of nitrogen are distributed rather uniformly over the lake as shown by the analyses of the waters taken from different stations which are about one mile from one another. The results given in table 2 also indicate that as soon as there is an accumulation of ammonia and nitrate nitrogen in the bottom waters there is a gradual upward diffusion of these forms of nitrogen. Merrill and Warner's springs that flow into Lake Mendota have a very high nitrate content, about 2800 mgm. NO_3 nitrogen per cubic meter of water. Due to the fact that they contribute only about 1 cu.m. of water per hour, they have little influence on the total volume of Lake Mendota, which is 478,370,000

cu.m. In February 1924 a special study was made of the extent to which Merrill and Warner's springs affect the nitrate content of Lake Mendota. The results showed that the spring water dilutes rapidly with the lake water, and at a distance of about 600 feet from the springs the nitrate content of the lake is about the same as that in the middle of the lake. In a previous paper (1) the analyses of other waters flowing into Lake Mendota were reported and the study at that time showed that all the ammonia and nitrate nitrogen flowing into Lake Mendota could account for only a small fraction of the rise in the nitrogen content that occurs in the lake during the winter months. These great increases in ammonia and nitrate nitrogen indicate that there are great biological activities going on in the lake even in the winter months. Some idea of the importance of these processes may be gathered from the fact that every 2 mgm. rise in the nitrate content means that about a ton of nitrates have been added to the lake waters.

Ammonification. Table 1 and figures 1 and 2 show the variations in the number of bacteria in both the top and bottom of Lake Mendota in 1925. In general the results agree with those reported in an earlier paper (17); namely, that the total number of bacteria in Lake Mendota water is variable and is not due to insufficient food. The occurrence and the activity of ammonifying bacteria in lake water were studied by means of plate counts. A comparison was made of the total number of microörganisms on sodium caseinate or Nutrose agar and beef peptone agar. The average difference between the count on the two different kinds of media was about 20 to 40 per cent higher on the Nutrose. The development of a large number of bacteria on the beef peptone agar was taken as indicative of the presence of ammonifiers. At times when the ammonia content in the lake water showed a marked rise, the approximate number of ammonifiers present was determined by means of Dunham's medium. A series of dilutions of the lake water was made and tubes of Dunham's medium inoculated. The tubes were tested daily for ammonia and peptone. The approximate number of ammonifiers grown on Dunham's medium compared very closely with the total number of bacteria grown on beef peptone agar. Figures 1 and 2 show the relationship that exists between the total number of bacteria and the ammonia content. In general, an increase in the number of bacteria was followed by an increase in the ammonia content of the water. This relationship is more noticeable in the bottom water

than in the surface water which is influenced at times by the abundant growth of plankton, as well as the inflowing and outflowing waters.

Nitrification. From the curves of figures 1 and 2 it will be seen that an increase in the rate of nitrification follows a rise in the ammonia content during the winter months. Due to the lack of oxygen in the bottom waters during the summer and fall months a rise in the ammonia in the bottom water was not followed by a rise in the nitrifying activity. As long as oxygen was present in the cold lower strata, nitrification proceeded. As shown in table 1 the rate of nitrification at 11°C. was almost as rapid as at 28°C.—about three to five days slower at 11°C. than at 28°C.

A special study was made at various times to see if both groups of nitrifiers were present in these lake waters. Tests were made for those forms which oxidize the ammonia to nitrites and the forms which oxidize nitrites to nitrates. The presence or absence of ammonia was determined with Nessler's reagent; the nitrites determined with Trommsdorf's reagent, and the nitrates with diphenylamin. Both forms were found present at all times and grew well at either 11°C. or 28°C., and hence indicate that nitrification may take place in the cold bottom lake waters as long as there is oxygen present. Such has been found to be the case in February and March when the waters are cold and the nitrate content increases rapidly in the bottom strata.

Nitrate Reduction. As shown in the figures, nitrate reduction occurred throughout the year and at all depths. At certain seasons this reducing activity was greater than at other times. Late in winter when the nitrate content was high or in midsummer and fall when the dissolved oxygen content was low, the nitrate reduction was found to be most active. In 1925 the nitrate reduction for Lake Mendota ranged from seven to twenty-two days for the surface water, and five to twenty days for the bottom water. Occasionally when the nitrate reduction was most active, dilution counts were made. About 500 to 1000 bacteria were found per cubic centimeter of water. In summer when the lake was well stratified the nitrate reduction was far more active in the bottom water than at the surface. The low temperatures prevailing at the bottom of the lake do not retard the nitrate reduction to any great extent. As shown in the tables the rate of reduction at 11°C. was only from two to four days slower than at 28°C.

2. *Chemical and bacteriological variations of the waters of Lake Monona*

Since March, 1925 the top and bottom waters of Lake Monona have been analyzed as frequently as those of Lake Mendota. The

TABLE 3

Bacteriological and chemical analysis of the waters of Lake Monona

DATE	DEPTH	BACTERIA PER CUBIC CENTIMETER	NITRATE REDUCTION IN DAYS		NH_3-N	NO_3-N	NITRIFICATION IN DAYS		DISSOLVED OXYGEN
			11°C.	28°C.			11°C.	28°C.	
1925	*meters*				*mgm. per cu. M.*	*mgm. per cu. M.*			*grams per cu. M.*
March	1	2900	10	6	168	73.5	30	18	10.6
	20	3000	10	6	668	192.3	20	16	2.9
April	1	3600	14	10	536	100.0	18	14	9.1
	20	3300	12	8	584	120.0	20	18	8.8
May	1	2500	14	9	522	99.5	20	16	8.2
	20	3200	10	6	668	145.0	18	14	6.0
June	1	2700	11	8	499	82.0	21	16	6.7
	20	3200	8	5	752	136.0	21	17	0.5
July	1	3300	9	5	476	52.0	24	20	7.7
	20	3400	6	3	1012	20.0	28	25	0.0
August	1	3200	10	6	248	49.0	22	19	8.5
	20	3600	6	4	1256	23.0	31	28	0.0
September	1	2800	13	8	283	68.0	22	18	7.5
	20	2600	10	6	1295	19.0	29	25	0.0
October	turn-over	3000	12	9	350	81	23	19	9.1
November	1	2900	13	10	415	99.0	22	18	10.5
	20	3200	14	11	485	105.0	20	17	9.5
December	1	3000	12	10	438	120.0	20	17	11.0
	20	3300	12	9	525	131.0	18	16	9.0

average monthly analyses are given in table 3 and some of these are plotted in figures 3 and 4. Throughout the entire season of 1925,

the total number of bacteria in Lake Monona was about 1000 to 2000 higher than in Lake Mendota. The majority of these organisms are active ammonifiers and grow well on Nutrose or beef peptone agar. The relationship between the number of bacteria and the ammonia content of the water is brought out in figures 3 and 4. Especially in the bottom waters of Lake Monona a rise or drop in the total number of bacteria is followed by a corresponding rise or drop in the ammonia content. As soon as the summer stratification

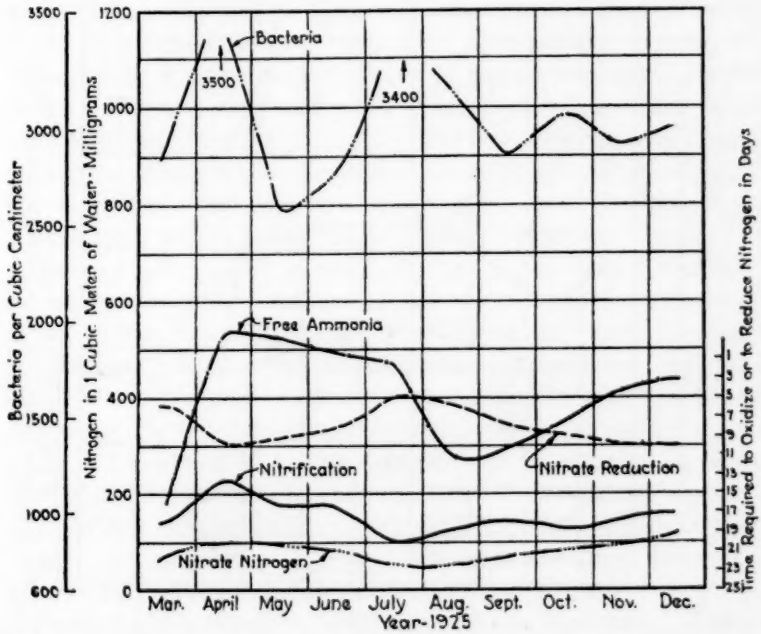

FIG. 3. NUMBER AND ACTIVITY OF CERTAIN GROUPS OF BACTERIA AND THE AMMONIA AND NITRATE CONTENT OF THE SURFACE WATERS OF LAKE MONONA IN 1925

began, the ammonia increased and the nitrate content decreased rapidly in the lower strata. The ammonia content in the lower layer of water rose as high as 1295 mgm. in Lake Monona in comparison to 697 mgm. per cubic meter in Lake Mendota before the fall turnover took place. The rate of nitrate reduction in Lake Monona was three to six days faster than that found during the corresponding months in Lake Mendota. During the spring and summer months when the nitrate reduction was most rapid in Lake Monona and Lake

Mendota, the nitrate content in the bottom water of Lake Monona dropped from 120 to 19 mgm. per cubic meter whereas in Lake Mendota the drop was from 72 to 12 mgm. per cubic meter. At the same time when this rapid nitrate reduction was going on in the Monona bottom waters, the dissolved oxygen disappeared more rapidly than in Lake Mendota. In the surface waters the dissolved oxygen also made a drop in both of these lakes as the season advanced from spring to summer, but this decrease was chiefly due to the lower solubility

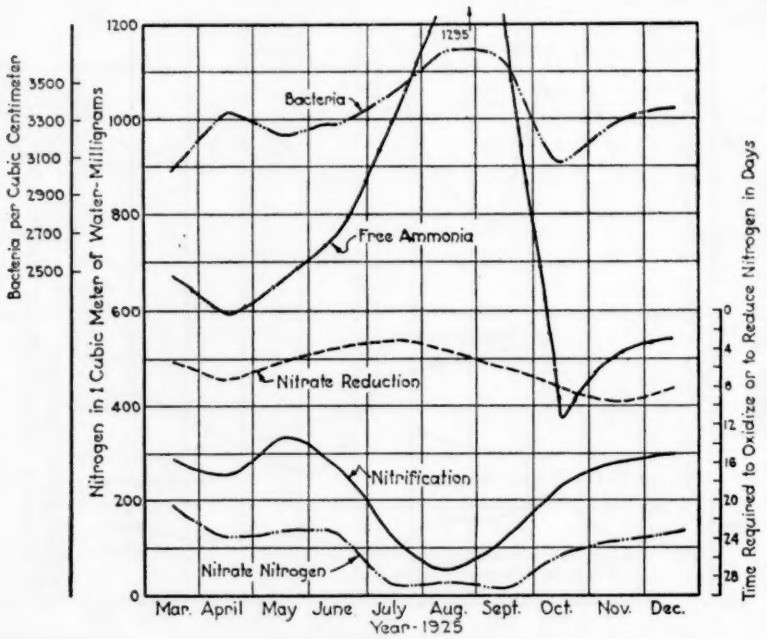

FIG. 4. NUMBER AND ACTIVITY OF CERTAIN GROUPS OF BACTERIA AND THE AMMONIA AND NITRATE CONTENT OF THE BOTTOM WATERS OF LAKE MONONA IN 1925

of the oxygen at higher temperatures. On the other hand, during the summer the temperatures of the bottom waters of Lake Monona as well as Lake Mendota remained rather high, around 16 to 18°C. Early in spring when the ammonia showed a marked rise in both the top and bottom waters of Lake Monona in the presence of a substantial amount of dissolved oxygen, the rate of nitrification became more active than during the other seasons of the year. At all times the rate of nitrification was from five to ten days faster in Lake Monona

than in the water of Lake Mendota. It is interesting to note that nitrification is so active in all of these lakes regardless of the presence of organic matter.

3. Bacteriological and chemical variations in the waters of lakes other than Lakes Mendota and Monona

Green Lake is the deepest inland lake of Wisconsin, having a maximum depth of 223 feet. This lake, like Lake Mendota, is a hard-water lake. Green Lake has regularly shown a higher bacterial count than Lake Mendota, about 1500 more per cubic centimeter of water, table 4. The rate of nitrate reduction was much slower in Green Lake, about sixteen days being required in comparison to only eight days for the time of nitrate reduction in Lake Mendota during the same month. In the fall the ammonia was lower, whereas the nitrate content was noticeably higher in Green Lake bottom waters than in the lower strata of Lake Mendota. In the Green Lake mud taken at 67 meters, like the mud of Lake Mendota, the ammonia was higher and the nitrate content was lower than that found in the waters about 2 meters above the mud. During the summer and fall the oxygen in the lower strata of Green Lake did not disappear entirely as was the case in Lakes Mendota and Monona. Consequently the rate of nitrification was rather active in Green Lake at a depth of 65 meters. During the fall months the average time of nitrification for the bottom waters of Green Lake was twenty days in comparison to thirty-nine days for Lake Mendota bottom water. In the spring, the rate of reduction was about twice as fast as that found to be the case in the fall months.

Devils Lake is a shallow, soft-water lake in Wisconsin. Although the total number of bacteria was considerably lower than that of Mendota, the rate of nitrate reduction was about as fast as that found in Lake Mendota. However, the rate of nitrification and the ammonia and nitrate content were considerably lower than that found in Lake Mendota.

Lake Michigan was the largest fresh water lake included in these studies. The bacterial count and the rate of nitrate reduction was lower than that found in most of the other lakes studied. The rate of nitrification was about the same as that found in Lake Mendota.

Lakes Waubesa, Kegonsa, and Wingra are a part of the chain of lakes to which Lake Mendota and Lake Monona belong. The waters of Mendota and Lake Wingra empty into lake Monona thence into

TABLE 4

Bacteriological and chemical content of lake waters

SAMPLE	DATE	DEPTH	BACTERIA PER CUBIC CENTIMETER*	NITRATE REDUCTION IN DAYS		NH_3-N	NO_3-N	NITRIFICATION IN DAYS		DISSOLVED OXYGEN
				11°C.	28°C.			11°C.	28°C.	
		meters				*mgm. per cu. M.*	*mgm. per cu. M.*			*grams per cu. M.*
Green Lake	10/11/24	1	4200	18	16	36	18.2		31	8.9
	10/11/24	65	3500	14	10	168	153.8		20	3.7
	10/11/24	67	3900	7	6					
	11/ 8/24	1	3800	20	18	40	18.3	36	29	9.2
	11/ 8/24	65	2200	10	10	184	159.6	24	19	3.9
	2/28/25	1	7800	14	10	69	23.9	38	30	12.7
	2/28/25	65	6600	8	4	206	57.7	28	20	9.2
	4/29/25	1	4900	10	8	90	27.8	35	28	9.1
	4/29/25	65	4800	11	9	95	29.5	36	28	9.1
	12/22/25	1	3900	24	20	72	30.5	30	25	
Devils Lake	11/28/24	1	500	11	11	37	14.2	47	45	10.2
	11/28/24	12	500	8	8	38	15.0	38	34	9.5
	2/ 4/25	1	300	23	20	53	16.7	42	39	13.3
	2/ 4/25	12	400	18	14	64	19.5	34	30	13.1
	5/ 4/25	1	700	10	8	57	17.5	38	35	10.8
	9/20/25	1	600	12	9	10	12.0	45	40	8.9
	12/ 6/25	1	300	13	12	41	18.5			10.1
Lake Michigan	2/ 8/25	1	800	24	20	102	50.0	34	30	12.7
	2/ 8/25	70	1000	20	14	164	83.0	28	25	6.2
	2/ 8/25	72	2200	13	10	204	79.0	25	20	
Lake Waubesa	3/16/25	1	2000	14	10	152	101.6	30	18	
	3/16/25	10	2600	10	6	508	156.2	24	17	
	5/ 2/25	1	2000	13	10	304	100.0	18	15	10.5
	6/ 8/25	0	2100	11	8	200	56.0	19	16	8.8
	7/24/25	0	2900	7	4	148	37.0	23	20	8.5
	7/24/25	8	3000	5	2	208	31.0	26	22	7.4
	8/19/25	0	2300	12	7	88	22.0	23	19	8.0
	8/19/25	8	2500	7	5	268	20.0			7.8
	9/17/25	0	1900	12	9	89	35.0	24	20	8.0
	9/17/25	8	2100	10	7	205	30.0			7.0
	10/ 5/25	0	3200	9	5	60	36.0	20	17	9.3

TABLE 4—*Continued*

SAMPLE	DATE	DEPTH	BACTERIA PER CUBIC CENTIMETER	NITRATE REDUCTION IN DAYS		NH_3-N	NO_3-N	NITRIFICATION IN DAYS		DISSOLVED OXYGEN
				11°C.	28°C.			11°C.	28°C.	
		meters				*mgm. per cu. M.*	*mgm. per cu. M.*			*grams per cu. M.*
Lake Kegonsa..	5/ 2/25	0	2300	13	6	232	110.0	19	16	9.4
	6/ 8/25	0	,2600	10	7	168	50.0	19	15	8.6
	7/25/25	0	2400	6	3	96	39.0	21	19	8.6
	7/25/25	6	4000	3	1	168	35.0	23	21	7.5
	8/20/25	0	2300	8	4	100	28.0	22	17	8.4
	8/20/25	8	2300	4	2	180	25.0			7.8
	9/17/25	0	2100	9	5	95	35.0	21	16	7.8
	9/17/25	7	1600	8	5	120	29.0			7.1
	10/ 5/25	0	4100	6	3	95	30.0	19	15	8.8
Lake Wingra...	5/ 8/25	0	900			108	150.0	17	14	8.0
	6/ 8/25	0	1200	14	10	100	196.0	18	16	7.8
	7/27/25	0	700	10	8	172	85.0	24	21	8.2
	7/27/25	5	700	9	7	180	82.0	22	20	7.6
	8/20/25	0	1500	13	11	64	55.0	25	20	8.5
	9/17/25	0	1000	15	12	75	51.0	27	21	8.5
	10/5/25	0	1500	13	8	62	39.0	20	17	8.0

* Bacteria grown on nutrose agar at 28°C.

Lake Waubesa and finally into Lake Kegonsa. The bacterial count as well as the ammonia content of Lakes Waubesa, Kegonsa, and Wingra was markedly lower than that found during the corresponding months in Lakes Mendota or Monona. In spring when the nitrate content was high, the rate of nitrification was two to five days faster in Lake Wingra than in any of the other lakes in that chain. As the season advanced from spring to fall the rate of nitrate reduction was more rapid in Lake Kegonsa than in the other lakes of that chain, due chiefly to the presence of a great number of nitrate reducers in the drainage waters that empty into this lake.

Nitrate reducing bacteria occurring in the different lakes were isolated and their morphology noted. By means of twelve enrichment transfers in Giltay's media and finally from Giltay's agar pure colonies of denitrifiers were obtained. These bacteria isolated from

the waters from various lakes were found to be of the same general type, viz., short rods with rounded ends, and stained solidly with gentian violet and carbol fuchsin. These organisms appear to have the same characteristics as some of those isolated from sea water by Drew (6), Kellermann and Smith (7), and Lipman (8). Under anaerobic conditions, they made a profuse growth.

SUMMARY

The seasonal fluctuations in the ammonia, nitrate, and oxygen content of lake waters was found to be due almost entirely to a seasonal variation in the bacterial flora of the lakes studied. These variations were noted in the surface waters, but were more marked in the bottom waters.

The ammonia and nitrate content reach a maximum about March, at a time when the ammonifiers and nitrifiers are most active. A marked rise in ammonification in the lower strata, especially in the mud, precedes the rise in nitrification which is most active about 2 meters above the mud. The increases are observed first in the bottom waters and later at various depths until finally they are noticed at the surface.

During mid-summer and fall the ammonia content increases as well as the activity of the ammonifiers in the lower strata. At the same time the oxygen disappears rapidly and nitrate reduction becomes more active than otherwise with the disappearance of the nitrates.

Ammonification, nitrification, and nitrate reduction often occur at the same time, yet at certain seasons of the year one of these processes is more marked than the others in the same lake.

Variations occur in the different lakes studied with respect to the time and predominant type of chemical change that takes place; that is, in winter when there is a marked rise in the ammonia and nitrate content, the ammonifiers and nitrifiers were found to be most active, and in summer when the ammonia increases and the nitrate and oxygen content decrease rapidly the ammonifiers and nitrate reducers are most predominant.

The rate of nitrate reduction and the rate of nitrification is about as active at 11°C. as at 28°C.

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RESIDUAL CHLORINE AND THE BACTERIAL CONTENT OF SWIMMING POOLS[1]

By E. B. Buchanan[2] and R. G. Perkins[3]

In the summer of 1923 a survey was conducted of 16 Cleveland swimming pools and it was found that there was no uniformity in methods of purification nor in the quantities of hypochlorite used when pools were chlorinated directly with hypochlorite. During the following fall and winter, conferences were held with various pool operators and steps were taken to unify the methods of treatment. Finally the simple method of daily use of chlorinated lime added at the rate of 0.5 part per million was adopted by all the pools.

In order to prove to the operators that such a system was efficient, bacteriological samples were taken hourly from 2 of the pools under consideration and examined for colon group organisms and total count.

It was found during the tests that there was at first a rapid decrease in bacterial count, and a total elimination of colon group organisms in 10 cc. portions of the water, even with bathers in the pool, but that later in the day there was a gradual increase in total count, not paralleled by increase of colon organisms (table 1) which indicated that the amount of available chlorine present late in the day was insufficient to destroy the more resistant types of bacteria.

This plan was continued throughout the year and the weekly analyses tabulated for several similar pools which were closely following instructions of the Health Division. A study of these figures revealed the fact that during the year there were several constant periods during which samples showed a decided increase in counts over the general average. These high points coincided with vacation periods for school children who were in the majority in using these pools, so that apparently more chlorine was used up in combining

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with the dirt introduced into the pool and less left for attacking the bacteria (see table 2).

This confirmed the previous conclusion that chlorination once a day was sufficient to remove colon group organisms, but might be insufficient to maintain a low count where there were so many bathers that the residual chlorine was completely utilized. In order to find

TABLE 1

	POOL A		POOL B	
	Count per cubic centimeter	Colon group	Count per cubic centimeter	Colon group
Before chlorination	5,000	Present in 10 cc.	2,300	Present in 10 cc.
1 hour after	5	None		
2 hours after	2	None	5	None
3 hours after	1	None		
5 hours after	3	None	5	None
7 hours after	7	None	1,000	None
9 hours after	13	None		
12 hours after	400	None		
	100 bathers—pool chlorinated 2 hours before opening		90 bathers—pool chlorinated 2 hours before opening	

TABLE 2

	NUMBER OF SAMPLES	AVERAGE AGAR COUNT PER CUBIC CENTIMETER	NUMBER SAMPLES WITH COLON GROUP
School year	34	283	None
Summer vacation	25	787	None
Winter vacation	9	1,414	1

what amount of chlorine would suffice to eliminate resistant strains as well as colon group organisms, tests were made at 3 pools involving various types of Cleveland bathers.

These tests were arranged so as to start with 0.5 p.p.m. available chlorine early in the day, and to make simultaneous bacteriological and residual chlorine tests at intervals throughout the day. These results are recorded in table 3.

These tests showed that there was a point somewhere between 0.1 and 0.2 p.p.m. chlorine at which the count would tend to increase, and since the rate at which chlorine is utilized is dependent largely upon the number of bathers, it was evident that chlorination once a day was insufficient to maintain a pool (having large numbers of bathers) in a satisfactory condition.

TABLE 3

TIME INTERVAL	TEST A			TEST B			TEST C		
	Colon group	Count	Chlorine	Colon group	Count	Chlorine	Colon group	Count	Chlorine
			p.p.m.			*p.p.m.*			*(1 pound added)* *p.p.m.*
Start	10 cc.	3,500	None	10 cc.	5,000	None	None	10,000	None
15 minutes	None	12	0.6	None	2	0.5+	None	10	0.4
1 hour	None	1	0.5+						
2 hours	None	1	0.5	None	2	0.5			
3 hours	None	1	0.5				None	50	0.15
4 hours	None	0	0.5	None	5	0.4			
									(½ pound added)
5 hours	None	0	0.5−				None	2	0.35
6 hours	None	0	0.4	None	2	0.3			
7 hours							None	50	0.15
8 hours				None	50	0.07			
9 hours							None	100	0.15
11 hours							None	300	0.06
15 hours	None	1	0.1						
18 hours				None	10,000	0.03	None	5,000	0.00
	Bathers using pool, 40—chlorinated 20 minutes before using			Bathers, 90—chlorinated 1 hour before using			Bathers, 103—chlorinated 1 hour before using		

To prove that it would be possible to maintain a pool having many bathers in a satisfactory manner by maintaining over 0.2 p.p.m., a test was conducted at a pool similar to the ones mentioned and it was found that the lower limit (0.2 p.p.m.) was reached about 4 p.m., so the operator was advised to add again one-half as much chlorinated lime in the evening as he had added in the morning, thus maintaining a +0.2 p.p.m. at all times. This was done daily and

samples taken over a period of eleven months. These figures are to be compared with three months' samples before maintaining in excess of 0.2 p.p.m. chlorine (see table 4).

This improvement was so remarkable that it was decided to provide each person in charge of a pool with an outfit enabling them to test their own pool for residual chlorine. In the event of their finding chlorine in excess of 0.2 p.p.m. they could be assured that their pool would be in a satisfactory bacteriological condition. At the same time it would make it possible for the Division of Health inspector to test a pool on the premises, thus eliminating the necessity of examination at the laboratory except in the case of pools showing less than 0.2 p.p.m. available chlorine.

The outfit shown in figure 1 is composed of a wooden block about 4 by 5 by 7 inches with three equally spaced holes bored through it just large enough to take standard 50 cc. color comparison tubes (no. 1). A thin strip of metal screwed to the bottom, overlaps the

TABLE 4

	NUMBER OF SAMPLE	AVERAGE COUNT	NUMBER OF SAMPLES WITH COLON GROUP
Before 0.2 p.p.m.	19	4,220	1
After +0.2 p.p.m.	30	27	0

upper edge of each hole sufficiently to prevent complete passage of the tube. The whole block is mounted on side plates so as to be steady at an angle of about 60°, permitting the reflection of light up through the tubes while the outfit stands on the table. A bottle of ortho tolidin and a dropper (0.5 cc. capacity) are provided with each outfit, the latter being kept in a small hole in the left hand corner of the top of the block (no. 4). Each tube is provided with a rubber stopper through which has been cut a hole of sufficient size to hold a $\frac{5}{8}$-inch test tube or flat bottomed vial (no. 2). This tube must be long enough to permit the bottom to be slightly below the surface of the contained solution. Small rubber stoppers (no. 3) are suspended from a movable wire bridge to be used to keep dust from collecting in the visibility tubes. When in use this bridge drops down out of the way. A test tube brush is mounted under the inclined surface of the block and may be used to remove dust from the visibility tubes (no. 5). The outside tubes are filled with copper sulphate,

potassium dichromate standard color comparison solutions equivalent to 0.2 and 0.5 p.p.m. chlorine. This solution will remain unchanged for at least nine months. The stopper is then inserted so that the $\frac{5}{8}$-inch tube extends slightly into the solution. The center tube is used to make the test; it is filled to the 50 cc. mark with swimming pool water, a dropper full (0.5 cc.) of ortho tolidin is added, the tube stoppered with one of the tube stoppers and the mixture shaken. This is then inserted into the central hole in the block and, after one minute, examined.

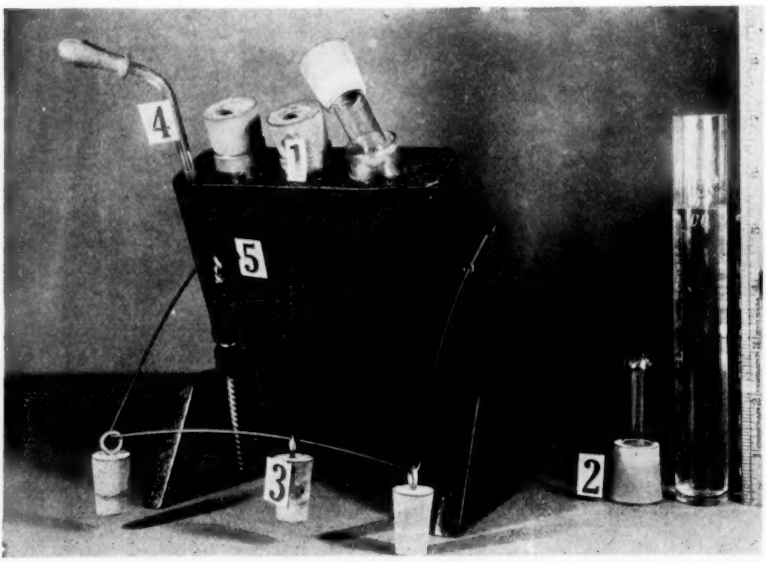

FIG. 1. CHLORINE DETERMINATION OUTFIT

If the color is more intense than the lighter tube, the operator knows his pool is all right; in the event it is lighter, it is advisable to add one-half as much chlorine as was added in the morning, which addition should again bring the color near that of the maximum tube. (0.5 p.p.m.).

SUMMARY

Maintenance of a minimum of 0.2 p.p.m. available chlorine in a swimming pool is sufficient to eliminate colon group organisms and ensure low agar counts.

Coöperation of pool managers in using the residual chlorine outfits provided by the Division of Health will result in safe swimming pools with the substitution of simple chemical control for more complicated bacteriological control.

ORTHO-TOLIDIN AND STARCH-IODIDE TESTS FOR FREE CHLORINE IN CHLORINATED SEWAGE TANK EFFLUENTS

WALTER V. D. TIEDEMAN[1]

Buswell and Boruff have discussed the relative sensitivity of ortho-tolidin and starch-iodide tests for free chlorine in a recent article in THIS JOURNAL.[2] We are led to comment on this subject in order to bring out certain points of general interest which have developed from attempts by the Division of Sanitation of the New York State Department of Health to make practical application of these two tests to chlorinated sewage tank effluents. We find a wide discrepancy between the results obtained by the ortho-tolidin, as compared with the starch-iodide, test when applied to relatively fresh domestic sewage.

Our interest in the application of a test for excess chlorine in chlorinated sewage effluents has been from the standpoint of practical plant operation in places where, due to nearby shellfish grounds, bathing beaches or water supplies, an effluent of low B. coli content is required. A general survey of sewage chlorination plants on Long Island, operating on a fixed chlorine dosage supposed to meet maximum requirements and treating effluents from either Imhoff or plain settling tanks handling only domestic sewage, revealed that the reduction in bacteria as a result of chlorination was slight under summer conditions in most cases. This was particularly true of the B. coli group. The fluctuation in the chemical demand for chlorine, probably due to differences in dissolved organic matter and gases such as hydrogen sulphide, was much greater than was commonly recognized. (1) Hence, in order to fix a rate of application for chlorine, to be used the year round, in parts per million, pounds per million gallons of sewage or pounds per day as most small plants operate, it is necessary to fix this on a basis of the maximum demand

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[2] November, 1925, page 384.

for chlorine under summer conditions and on a basis of maximum flow. Our experience indicates that to do this is increasing the operating cost for chlorine to the point where the question is raised as to whether more complete treatment would not be more economical. (2) It was also found that plant operators were inclined to look upon the proper chlorine dosage as a matter of the application of a fixed number of pounds per day and that in plants located in rapidly developing sections the rate of sewage flow might increase as much as 50 per cent over that on which the chlorine dosage was estimated, without any increase in the amount of chlorine used. There was also a tendency to base the rate of applying chlorine upon the average rather than the maximum daily flow. (3) In some sewage disposal plants, there were no means of measuring the sewage flows and the amounts of chlorine added daily were based on rough estimates which were generally low. (4) The control of sewage disposal plants by bacterial analyses was also found to be unsatisfactory. This was due principally to the fact that several days were required to secure presumptive results and, where work was done in city laboratories, additional time was consumed shipping samples and returning the report. Another unsatisfactory factor, where bacterial samples were shipped for examination, was that excess chlorine was not removed from the samples and where an excess was present, the reaction period for the chlorine included the time it took to ship samples to the laboratory.

All these conditions pointed to the advantages of securing some quick test that would indicate when satisfactory removal of bacteria was being obtained. Steps were taken to determine the possibilities of operation on an excess chlorine basis as indicated by either the ortho-tolidin or the starch-iodide tests as is done in water chlorinating plants.

Since the turbidity of sewage interferes with the reading of excess chlorine by the ortho-tolidin method in Nessler tubes, these tests were made in ordinary one ounce prescription bottles following a suggestion by L. H. Enslow. A bottle of the sewage or effluent being tested was placed in front of the standard to get the effect of the turbidity and a bottle of plain water was placed in front of the bottle of sewage or effluent to which the ortho-tolidin had been added, to equalize the depth of liquid and amount of glass looked through. The comparison was made by looking through the two bottles in each case.

At least 1 cc. of standard ortho-tolidin solution is necessary to

produce the reaction in the small bottles (about 4 cc. per 100 cc.). The length of time required to reach the maximum reading was from 5 to 15 minutes, depending particularly upon the temperature and strength of sewage. In some cases with cold sewage as much as 30 minutes was required for the color to reach a maximum. It was found that the addition of about 2 cc. of concentrated hydrochloric acid per 100 cc. of sample added after the ortho-tolidin or immediately before would speed up the reaction, but if two or three minutes' time were allowed for the acid to react before the ortho-tolidin was added, the latter would develop no color at all. At 5.5°C. an excess of 2.9 p.p.m. in sewage by the ortho-tolidin standard was developed in twenty-five minutes whereas in a sample of the same chlorinated sewage warmed to 21.5°C. the same maximum reading was obtained in 5 minutes. It was also noted that reactions with ortho-tolidin are much slower with strong sewages than with weak sewages and that the color fades rather rapidly in a strong sewage.

As a check on the ortho-tolidin test the excess chlorine was determined by titration with N/100 sodium thiosulphate using c.p. potassium iodide crystals and acidifying with about 3 cc. per 100 of glacial acetic acid and using starch solution as an indicator. It developed that the excess chlorine indicated by this titration with relatively fresh chlorinated tank effluents was always much higher than the excess indicated by the ortho-tolidin test. The difference was neither fixed nor directly proportional, but varied with the strength of the sewage and the amount of the excess. Some of these comparative results are listed in table 1.

It is difficult to explain definitely the difference in results obtained by the two tests. Chlorine very likely enters into some combination which does not react with ortho-tolidin, but which is released by acidification and reacts as free chlorine in the starch-iodide titration.

In order to check the solutions and computations a few excess chlorine determinations were made on tap water treated with chlorine, bleach and zonite, respectively. With these substances the results checked more closely, although there was a tendency for the ortho-tolidin test to give higher rather than lower results. Some of the results obtained are shown in table 2.

The higher values for excess chlorine by the ortho-tolidin test may be partially explained by the fact that the standards used in the small bottles were prepared for use in 100 cc. Nessler tubes. A reading of

the excess chlorine in a zonite solution by the ortho-tolidin test in the small bottle as compared with the Nessler tube was 2.5 against 2.0. Further work is contemplated in determining this factor.

TABLE 1

Comparison of results of determination of excess chlorine by ortho-tolidin and by starch-iodide titration†*

EXCESS (O-T‡)	CHLORINE (S-I§)	EXCESS (O-T‡)	CHLORINE (S-I§)	EXCESS (O-T‡)	CHLORINE (S-I§)	EXCESS (O-T‡)	CHLORINE (S-I§)
0	0.4	0.4	4.8	1.4	3.1	2.5	7.9
0	0.9	0.5	3.5	1.5	7.0	2.7	4.5
0	1.3	0.5	8.0	1.6	4.0	2.9	4.0
0	1.8	0.7	1.4	1.8	8.6	3.0	4.4
0	2.2	0.7	3.3	2.0	4.9	3.0	5.1
0	2.6	0.7	3.8	2.0	5.3	3.0	5.8
0	3.1	1.0	4.2	2.2	4.0	3.0	8.8
0	3.5	1.0	5.3	2.2	6.6	3.0	15.0
0.1	5.3	1.2	3.8	2.3	4.2	3.2	4.5
0.2	2.8	1.3	3.2	2.3	6.1	3.2	7.7
0.3	2.6	1.3	3.3	2.5	5.8		

* Results are for various samples of chlorinated sewage tank effluent at various times.

† Acidified with acetic acid.

‡ O-T. Ortho-tolidin test.

§ S-I. Starch-iodide titration using acetic acid.

TABLE 2

Excess chlorine in tap water

TREATMENT	BY ORTHO-TOLIDIN	BY STARCH-IODIDE (USING ACETIC ACID)
Treated with chlorine	2.8	2.0
	1.5	0.7
	3.5	2.8
Treated with bleach	3.4	2.4
Treated with zonite	2.5†	2.1

* Readings made in 1-ounce bottles as for sewage tests, using 1 cc. of ortho-tolidin solution.

† A reading of 2.0 was obtained on the same solution in a 100 cc. Nessler tube using 1 cc. of ortho-tolidin solution.

As a further check on the work, The Division of Laboratories and Research sent out a man from the Albany laboratory who substan-

tially duplicated the results. He also pointed out that the starch-iodide test omitting the acetic acid gave results which checked approximately the readings obtained by the ortho-tolidin test. Comparative readings on the same sample of chlorinated sewage by various methods gave the results in table 3.

The determination by unacidified starch iodide titration approximately checks the result by the ortho-tolidin test and the result of the determination by the starch-iodide method using hydrochloric acid is slightly higher than that obtained by using acetic acid. Other results have borne this out.

To determine the bacterial removal obtained with various excesses of chlorine by the ortho-tolidin test, as compared with starch-iodide titration using acetic acid, a series of bacterial samples were taken and sent by special messenger to the New York City branch laboratory of the Department for analysis. In order to terminate the

TABLE 3

Comparative tests for excess chlorine by ortho-tolidin and by starch-iodide titration with and without acid

1. By ortho-tolidin test*	3.0
2. By starch-iodide titration *without acid*	2.8
3. By starch-iodide using 0.3 cc. glacial acetic acid per 100 cc	5.1
4. By starch-iodide using 4 cc. of 10 per cent HCl† per 100 cc	5.8

* In 1-ounce bottles using 1 cc. of ortho-tolidin solution.

† Equivalent to the amount of HCl used in the ortho-tolidin test.

period of contact of the excess chlorine at a definite time, sufficient sodium thiosulphate to neutralize the excess chlorine was used. It was determined that the sodium thiosulphate solution did not inhibit bacterial growth, but, notwithstanding this fact, only a slight excess over the amount indicated as necessary by starch-iodide titration using acetic acid was added. Some of the results are given in table 4. The tests for the B. coli group are the completed tests of "Standard Methods." These tests were made during October and November and the total demand of the sewage for chlorine is much lower than under summer conditions.

The first series was made with fixed chlorine dosage sufficient to give a decided excess by the ortho-tolidin test. The detention period was varied for the purpose of determining whether removal of B. coli could be obtained with short detention periods under these conditions. The shortest period (8 minutes) shows a removal of bacteria on agar

TABLE 4

Summary of results of bacterial analyses of sewage tank effluent at Huntington, Long Island, New York

New York State Department of Health

	DATE	SOURCE OF SAMPLE	CHLORINE DOSAGE (CALCULATED)	EXCESS CHLORINE				REACTION PERIOD	BACTERIAL COUNT		COMPLETED TEST FOR B. COLI					
				Initial*		Final†										
				Orthotolidin	Acetic starch iodide	Orthotolidin	Acetic starch iodide		At 20°C. on gelatin	At 37°C. on agar	10 cc.	1 cc.	1/10 cc.	1/100 cc.	1/1000 cc.	1/10000 cc.
	1925		*p.p.m.*	*p.p.m.*	*p.p.m.*	*p.p.m.*	*p.p.m.*	*minutes*								
	10/22	Raw sewage							2,200,000	2,500,000	2+0−	2+0−	2+0−	2+0−	2+0−	2+0−
		Untreated tank effluent							1,900,000	2,300,000	2+0−	2+0−	2+0−	2+0−	2+0−	0+2−
Series I		Treated tank effluent	13	0.5	8.0		7.0	8‡	1,000	1,800	2+0−	2+0−	2+0−	2+0−	0+2−	0+2−
		Treated tank effluent	13	0.5	8.0		7.0	15	800	600	2+0−	2+0−	2+0−	1+1−	0+2−	0+2−
		Treated tank effluent	13	0.5	8.0		6.6	30	900	7,300	2+0−	2+0−	2+0−	2+0−	0+2−	0+2−
	10/28	Untreated tank effluent							1,200,000	1,400,000	3+0−	3+0−	3+0−	3+0−	3+0−	0+3−
		Treated tank effluent	2.7	0	1.3	0	0.9	10§	150,000	140,000	3+0−	3+0−	3+0−	3+0−	3+0−	0+3−
Series II		Treated tank effluent	2.7	0	1.3	0	0.9	20	140,000	65,000	3+0−	3+0−	3+0−	3+0−	3+0−	0+3−
		Treated tank effluent	2.7	0	1.3	0	0.4	30	74,000	5,500	3+0−	3+0−	3+0−	3+0−	3+0−	0+3−
		Treated tank effluent	2.7	0	1.3	0	Trace	60	29,400	2,100	3+0−	3+0−	3+0−	3+0−	2+1−	0+3−
	11/5	Untreated tank effluent							15,700,000	1,200,000	3+0−	3+0−	3+0−	3+0−	3+0−	1+2−
		Treated tank effluent	7.4			0	3.1	15	400	300	3+0−	3+0−	0+3−	0+3−	0+3−	0+3−
		Treated tank effluent	9.5			0	3.5	15	3,400	100	3+0−	3+0−	3+0−	0+3−	0+3−	0+3−
Series III		Treated tank effluent	11.2			0.4	4.8	15	300	0	3+0−	3+0−	0+3−	0+3−	0+3−	0+3−
		Treated tank effluent	12.8			2.2	6.6	15	300	100	3+0−	3+0−	0+3−	0+3−	0+3−	0+3−
		Treated tank effluent	14.3			2.5	7.9	15	800	0	3+0−	3+0−	0+3−	0+3−	0+3−	0+3−
		Treated tank effluent	15.3			3.0	8.8	15	0	200	3+0−	0+3−	0+3−	0+3−	0+3−	0+3−

Series IV	11/17	Untreated tank effluent							7,600,000	1,600,000	3+0−	3+0−	3+0−		3+0−	0+3−
		Treated tank effluent		0.8		0.6	2.7‖‖	15	0	40	0+3−	0+3−	0+3−	0+3−	0+3−	0+3−
		Treated tank effluent		0.8		0.6	2.7††	15	40	70	1+2−	0+3−	0+3−	0+3−	0+3−	0+3−
		Treated tank effluent		0.8		0.6	2.7‡‡	15	1,400	3,000	0+3−	1+2−	0+3−	0+3−	0+3−	0+3−
		Treated tank effluent				2.9	6.0‖‖	15	10	90	0+3−	0+3−	0+3−	0+3−	0+3−	0+3−
		Treated tank effluent				2.9	6.0††	15	30	90	0+3−	0+3−	0+3−	0+3−	0+3−	0+3−
		Treated tank effluent				2.9	6.0‡‡	15	3,700	27,000	3+0−	3+0−	3+0−	2+1−	0+3−	0+3−

* Determined immediately after the addition of the chlorine.

† Determined at the end of the reaction period after which the excess chlorine was neutralized by adding a slight excess of sodium thiosulphate above mount indicated as necessary by the starch iodide titration using acetic acid except as noted in footnotes **, †† and ‡‡.

‡ Estimated period of detention in chamber. Longer periods in this series represent detention in a pail out of doors.

§ All detention periods represent detention in a pail out of doors.

‖‖ Excess removed by adding an amount of sodium thiosulphate indicated by the unacidified starch iodide titration.

†† Excess removed by adding an amount of sodium thiosulphate indicated by the starch iodide titration using acetic acid.

‡‡ Excess removed by adding an amount of sodium thiosulphate equal to 10 times that indicated by unacidified starch iodide titration.

at 37° of 99.29 per cent and the absence of B. coli in $\frac{1}{10,000}$ cc. with the presence of B. coli in $\frac{1}{100}$ cc., which may be considered very satisfactory for average conditions. The second series was run with fixed chlorine dosage low enough to give no reaction for excess chlorine by the ortho-tolidin test but a slight excess by starch-iodide titration using acetic acid. The detention period was varied with a view to determining whether such an excsss would give satisfactory bacterial results with short detention periods. The results indicate a removal of bacteria according to the 37° count of from 90 per cent for ten minutes detention to 98.5 per cent for one hour detention, but practically no reduction in B. coli with less than one hour's detention and even then 2 out of 3 of the $\frac{1}{10,000}$ cc. portions were positive. These results would indicate that the bacterial effect of the chlorine combinations reacting as free chlorine by acidified starch-iodide titration, but giving no reaction by ortho-tolidin, cannot be depended upon for a material reduction of colon bacilli where the detention period is one hour or less. The third series was run with a fixed detention period but variable chlorine dosage. Unfortunately the range of chlorine dosage was not started low enough to bring out the point where good bactericidal action began. It is of interest to note that good results were obtained with the first two samples in this series in which samples no excess of free chlorine was indicated by the ortho-tolidin test. It may be noted, however, that in these instances the excess by starch-iodide (acidified) titration was more than 3 p.p.m. The fourth series of samples was collected for the purpose of determining the effect upon the bacterial results of the addition of sodium thiosulphate solution for the removal of the excess chlorine. This series consists of two sets each comprised of 3 identical samples of chlorinated tank effluent which have been treated after 15 minutes reaction with varying amounts of sodium thiosulphate tending to neutralize the excess chlorine. The results of this series show: (1) That sodium thiosulphate solution in decided excess over that necessary to neutralize the free chlorine apparently has no inhibitory effect upon the growth of bacteria of the B. coli group and (2) that a slight excess of sodium thiosulphate is necessary and a decided excess preferable to make sure that no chlorine combination remains which might react in the sample on the way to the laboratory.

In conclusion it may be said that:

1. The variations during the course of the year in the chemical demand for chlorine in the effluents of tanks treating ordinary domestic sewage are greater than are commonly recognized.

2. Many sewage chlorination plants treating Imhoff or plain settling tank effluent on a fixed chlorine dosage of 15 p.p.m. were turning out unsatisfactory effluents from the standpoint of B. coli removal and in a few instances showed only slight bacterial removal under summer conditions.

3. In operating sewage chlorinating plants on the basis of a definite number of parts per million of chlorine to be applied the year round, we must fix this figure high enough to produce good results under summer conditions,[3] i.e., under conditions requiring a maximum amount of chlorine. This raises operating costs materially indicating the advantages of varying the dosage as in operating on an excess chlorine basis.

4. The ortho-tolidin test for excess chlorine is applicable to sewage tank effluents by substituting 1 ounce prescription bottles for Nessler tubes, increasing the amount of ortho-tolidin and allowing for the turbidity as described, although results are at variance with those obtained on fresh sewages by starch-iodide titration using acetic acid. In other words, the ortho-tolidin test is a valuable index regardless of whether or not it is a true measure of excess chlorine.

5. Tests indicate that good bacterial removal and reduction in B. coli can be obtained in chlorinated effluents of tanks treating domestic sewage when a slight excess of chlorine is indicated by the ortho-tolidin test.

The practical operation of the sewage treatment plant at Huntington, Long Island, New York, has been started on an excess chlorine basis and monthly chemical and bacterial samples to be collected throughout this year should add interesting data. The bacterial work on these samples includes the examination of the suspended solids for B. coli.

[3] At the Port Washington plant about 26 p.p.m., i.e., 215 pounds per million gallons were necessary to secure good results late in August.

THE NEED FOR DATA RELATING TO WATER[1]

By N. C. Grover[2]

Water is the most valuable of minerals. Man can do without iron, copper, silver, or gold, but he cannot get along without water, which is essential to all life whether plant or animal. It must be available for domestic and municipal supplies in such quantities and of such quality as to maintain comfort and health, and to supply the ordinary household needs; for all growing crops—in humid regions by the natural processes of nature in the form of rain and snow and in arid regions by means of artificial systems of irrigation; for process uses in industry, many of which need water of clarity and purity; and for water-power and steam-power plants to supply the electric energy which lights our homes and streets, drives our railway cars, and operates our factories. Whether energy is obtained from falling water or burning fuels, water is essential and limits the capacity of the steam plant just as surely as it does the hydraulic plant. In addition, water plays an important part in all recreation and is essential to bathing, boating, canoeing and fishing.

Air is also necessary to life, but except under unusual conditions of congestion or stagnation it is available at all times and places in any quantity and of good quality at no cost. But water is not always available; it is definitely limited in quantity and is often of poor quality. It must be diverted from streams by means of expensive dams and canals or pipe lines, or it must be pumped from the ground, stored in reservoirs, softened, filtered, clarified, purified, sterilized, decolorized, deodorized and what not, in order to meet the requirements of modern man. As water lacks in quality, its utilization becomes more expensive and less satisfactory. Moreover, it must be available at the instant on the turning of the faucet in the home of our present civilization. Under these conditions water is not and cannot be free. The user must pay the cost either in the form of a water bill or in his general taxes, or in the cost of a private supply obtained from well or stream by means of pump or gravity aqueduct.

[1] Presented before the Iowa Section meeting, December 3, 1925.

[2] Chief Hydraulic Engineer, U. S. Geological Survey, Washington, D. C.

Water forms the foundation of value in many modern developments and activities which are limited by the quantity of water available. The great marvel of the times is the continued enormous growth in the use of electrical power. The statistics collected by the United States Geological Survey show that during the last five years this use has increased at the rate of more than 10 per cent a year, with no present sign of abatement. The great use of this force, which is at the foundation of our present prosperity, has relieved labor of much of its drudgery, has given each laborer, on the average, several horsepower of cheap assistance, enabling him to double and triple his earning capacity, has changed the whole scale of living, and has made the ordinary home of today more livable and healthful than a king's palace of a century ago. This situation has been set forth in Secretary Hoover's report for the Department of Commerce for the year ending June 30, 1925.[3]

As water is expensive when made available for use, mistakes should be avoided in the planning of water supply systems that may fail in whole or in part to serve the uses for which they are designed. The quantity and quality of water must be carefully studied at its source, and full and reliable data must be available as a basis for all plans for using it.

The supply of water is strictly limited and the total quantity in any region cannot be changed. It may be stored from periods of floods to periods of drought or it may be supplemented in one river basin by diversion from another, but except by these obvious and simple, though sometimes expensive, expedients the available supply cannot be increased. The limit of the supply that may be obtained from the ground, though not as obvious, and generally not as surely measurable in advance of use, is just as definite. No more water can be pumped from the ground in a given region than flows into it at such places and times as to reach the pumps.

The water in surface streams which form our principal source of supply, varies widely in quantity from season to season and at low stages is not generally sufficient for the uses that are made of it. It varies also in quality with variations in stage, and at times, even after expensive chemical treatment, serves very unsatisfactorily and inefficiently the needs of man for domestic or industrial use.

A knowledge of either or both the stage and discharge of rivers is needed in connection with the design and construction of flood protec-

[3] Reviewed in The Literary Digest, December 12, 1925, p. 12.

tion works, the determination of the necessary capacities of culverts and bridge openings, the elevations of grades of railroads and highways, and the elevations of buildings situated on the banks of rivers or on their flood plains. For these uses there is involved a necessity for topographic maps in connection with the determination of capacities of possible storage reservoirs, and with planning the routes for canals and other diversion conduits, also for information on the geologic structure of beds and banks with respect to their strength for supporting dams and other structures, and to their water tightness when subjected to considerable hydrostatic pressures.

With the development of the country and its growth in population, industry, and commerce, there has been a steady increase in the need for water. As towns and cities have continued to grow, new and increased supplies of soft, unpolluted water must be sought or the supplies now used that are not safe for drinking or satisfactory for household use must be so treated as to make them safe and satisfactory.

There is constant searching for more and better water for industrial processes, and both the quantity and quality of the available supplies of water now determine the locations chosen for many industries. In order that reliable information as to water supplies shall be available when use for it arises the needs of the future must be anticipated, because time is required for getting the records. If action is delayed, the records will not be available when needed and there will be many failures of hydraulic projects because developments will necessarily have been made without sufficient information to show the limits and qualities of the supplies of water upon which reliance is to be placed.

As would be expected, the increased use of water has been reflected in a growing demand for fundamental data as to the quantity and quality of the water flowing in all of our rivers and to be obtained from the ground, and in an appreciation of the value of water and of the importance of knowledge of its quantity, quality, and availability. The United States Geological Survey is the authorized Federal agency for collecting and publishing data pertaining to water and is the recognized source of reliable information on all questions relating to water supply.

The demand for information as to water has led many States to coöperate with the United States Geological Survey and to appropriate large amounts of money for use in such coöperation, which

has grown in recent years until the Survey does little more than furnish the equivalent of salaries of the supervising officials; other expenses being paid by the coöperating parties. During 1925, the total Federal appropriation was $165,000, and during the same year more than $400,000 was furnished by states, counties, and municipalities, and by corporations operating under the Federal Water Power Act. The continued demand for extension of the resources of the Geological Survey to be used in this coöperation has recently culminated in the effort of the American Engineering Council to provide for an inventory[4] of the country's water resources and to establish an adequate program for collecting and publishing the basic facts.

In a statement concerning the needs for this inventory, American Engineering Council has summarized the reasons why the work should be centralized and systematized under the United States Geological Survey as follows:

1. The Geological Survey is primarily a bureau of research and investigation that collects systematically and publishes for general information and use data in regard to the natural resources of the country and it is recognized as an authorized Federal agency for collecting and publishing information in regard to all questions relating to water resources of the country.

2. The Geological Survey has an established personnel and facilities for carrying on the investigations. The methods used in conducting the work have been developed as a result of years of experience and have been accepted as standard throughout the United States, and foreign countries. This insures coördination and standardization of all investigations conducted by the Geological Survey or under its supervision.

3. The work of the Geological Survey is on a continuing basis and is reasonably free from danger of interruptions with changes in administration.

4. The Geological Survey is in position to make data readily available to the public by means of its publications and of other facilities.

5. It is highly important that base data in regard to water and other natural resources be collected by an unbiased agency not directly interested in construction or administration of specific projects or of specific types of projects in order that the public may have absolute confidence in the results. Moreover, agencies responsible for construction or administration are most soundly fortified if their actions are based on information collected by an accredited federal investigational bureau whose primary responsibility is that of making available unbiased facts.

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[4] H. R. 6358, 69th Congress, 1st Session.

SEISMIC ACTIVITY IN SANTA BARBARA[1]

By V. E. Trace[2]

On the previous day of the disaster, June 28, at 8:15 p.m., 1925, the recording pressure gauge registered a slight disturbance and was so recorded on the seismograph in the City of Pasadena.

June 29, 1925 at 6:42 a.m. the heavy shock occurred lasting about nineteen seconds. The pen point on the pressure gauge was thrown from 140 to 175 pounds. The destruction of two of the main trunk lines drained the system and within ten minutes the water pressure registered 5 pounds, and within less than thirty minutes thereafter, through the quick action of the Water Department employees in closing the damaged sections of the system, the pressure in the system was restored and it is with gratitude I wish to state that the employees responded without call and were ready to render their assistance immediately following the disaster. At 10:45 a.m. the pressure was 75 pounds and at 12:00 noon was normal.

Through the destruction of the dam at Sheffield Reservoir, two sections of the East Transmission Main to the lower distributing reservoir no. 1, the 16-inch distributing main from reservoir no. 1 and a 6-inch main crossing Sycamore Canyon Creek were washed out.

Carl Wyant, Engineer and Superintendent of the Montecito County Water District, with his employees were on hand to render assistance and were certainly appreciated. The two sections of the East Transmission Main were replaced by them and the service of reservoir no. 1 was resumed within forty-eight hours.

The first break in the system noticed was the 12-inch Class B Cast Iron Main on State Street, and was caused by the falling of a top wall from a three story building landing directly over, and driving the pavement 3½ feet into the ground. Two blocks of this main were closed off leaving one fire hydrant at each street intersection available for fire service.

The 16-inch main crossing Sycamore Canyon Creek was closed

[1] Presented before the California Section meeting, October 15, 1925

[2] Superintendent, Water Works Department, Santa Barbara, Calif.

off by gates being located on each side of the stream, leaving an 8-inch main still intact from reservoir 1 that passed over a concrete arch bridge which was not damaged.

Two blocks of the 6-inch main crossing this stream were closed and later plugged at the embankment and service resumed to the consumers.

During this operation the writer with other employees proceeded to the Sheffield Reservoir for investigation and found it was destroyed, but the supply main was still in operation. Gates were operated and the water by-passed into the transmission mains from Sheffield Reservoir, supplying reservoirs 2 and 3 located near the old Mission, and also reservoir 1. We then proceeded to the South Portal of the Mission Tunnel and got in communication by phone with the caretaker at Gibraltar Dam. He reported no damage.

Observations of the ventilation and weir measurements of the flow of water through the tunnel were taken every half hour by the caretaker to ascertain if any obstruction had taken place in the tunnel.

No decrease in the flow was observed at any time, but there was an increase which was due to the opening up of additional springs in the tunnel, which increase was about 75 per cent or 1,000,000 gallons per day.

After reporting to Herbert Nunn, our City Manager, that the water supply was in operation, I proceeded to investigate the additional damage to the distributing system.

The 8-inch cast iron main that crosses the bridge on Haley Street broke within 6 inches of the concrete wall, a section was removed and replaced by the use of two sleeves, all joints calked with lead, without removing a section of the wall.

The 8-inch cast iron main on Mason Street, between State and Bath Streets was severely shaken, causing several leaks in lead joints, also fracturing two cement joints and shearing off several services at the corporation cock.

On Chapala Street, between Mason and the West Boulevard, one cement joint was fractured and one service sheared off. The most severe movement occurred in this section of the City since it is in or near the fault line and on filled ground.

The south rail on the Santa Barbara Suburban Railroad on the West Boulevard was bucked and twisted. The pavement on Mason Street was raised and overlapped and several sections of curbing broken.

A section of the 8-inch de Lavaud cast iron pipe in Cliff Drive near the Arroyo Burro Creek moved ahead 2½ inches and was replaced with a longer section. At the end of this line an 8-inch gate valve was broken without fracturing the de Lavaud cast iron pipe.

In various sections of the City where 2-inch standard pipe was installed the joints were buckled.

At the pumping station, the 10-inch standard screwed discharge main from the pumps connecting with the distributing system, separated at the joints. The caisson, 30 feet deep and 25 feet in diameter,

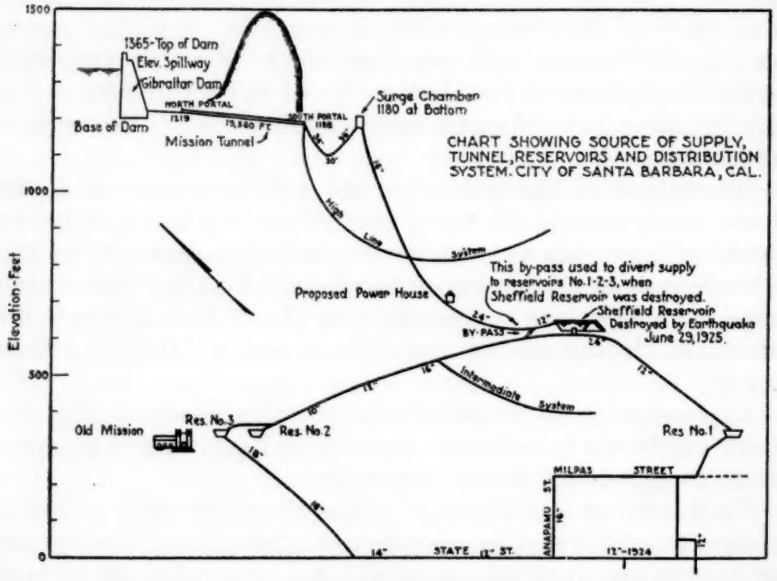

FIG. 1

was fractured and flooded the pumping pit with water. The brick walls housing the boiler room were demolished.

In Montecito Street, between Bath and Castillo Streets, a lead joint was leaking and the expansion joint in the pavement raised. In Bath Street, between Haley and Cota Streets, one lead joint was leaking and the pavement was shattered. At the intersection of San Pasqual and Ortega Streets a gate box cap was sheared off from the socket.

The supply main between the South Portal of the Mission Tunnel and the concrete surge chamber, consists of 30 and 36-inch continuous redwood stave pipe and 36-inch reinforced concrete pipe. The

concrete pipe being a short section of about 50 feet, connecting with the surge chamber and the redwood pipe, was cracked in three places; two were vertical and one horizontal in the elbow underneath the surge chamber. One vertical crack was repaired by the construction of a concrete sleeve, a space was left over the crack and filled with black adobe and thoroughly tamped. The other vertical crack was repaired by the use of a steel sleeve placed on the inside. The joint was packed with oakum, black adobe and the face calked with lead wool. The horizontal crack was chipped out and calked with lead wool and a plastic of duck mastic was placed over the lead wool, covering the crack.

The dam forming the Sheffield reservoir was a puddled earth-fill, maximum height 25 feet and 800 feet long, without a drainage system. The face of the fill was puddled with black adobe, 4 feet at the bottom and 2 feet at the top and 9 feet in depth below the bottom of the reservoir, a concrete cut-off wall 1 foot thick and 5 feet in depth, placed in front of the adobe, the concrete lining extended therefrom covering the face of the dam.

Upon examination of the old structure that was left after the major portion went out, we found that the adobe facing and cut-off wall was perfect, no water having percolated through the adobe, but the hydrostatic pressure in the reservoir caused the water to percolate underneath the cut-off wall and adobe fill and saturate the bottom of the main structure.

When the heavy shock took place, the dam opened near the south end and about 500 feet in the center slid out on a hinged form.

The destruction of the dam at Sheffield Reservoir reduced the storage of water supply, near the City, from 43 to 4 million gallons. The water supply being diverted from the Gibraltar Reservoir required an excess of water to supply the system, therefore, causing more or less waste of water. Immediately steps were taken to reconstruct the dam on the old site for temporary storage of 8 to 10 million gallons, but the construction was of permanent nature until such time that finances could be raised to restore the original capacity.

After completing the temporary storage of the Sheffield Reservoir, inspection was made of the Mission Tunnel, 19,560 feet in length, through which the water supply from Gibraltar Dam is diverted. No disturbance was observed.

Immediately following the disaster, June 29, it was reported that

the water supply of the City of Santa Barbara was contaminated. This statement was uncalled for. The water diverted from the Gibraltar Reservoir through the tunnel is chlorinated at the South Portal, making the water safe at all times for domestic purpose supplying high service and before entering Sheffield Reservoir. Another plant was at Sheffield Reservoir and chlorinated the water passing through the transmission mains to the lower reservoir.

Considering the intensity of the seismic activities in our City, the result of the damage to the distributing system was negligible compared with the damage to buildings and other structures. There was only one cast iron pipe on this system that actually broke from the movements of the earth.

The greatest menace to be considered is the falling of walls from high buildings into the streets, causing the destruction of water mains and appurtenances.

ENGLISH COMMENTS ON ADDITION OF IODINE TO DRINKING WATER TO PREVENT THYROIDISM[1]

One of the most remarkable prophylactic experiments of recent times is being carried out at Rochester (U. S. A.) by which iodine in the form of sodium iodide is being added artificially to the water supply twice a year for a period of some two or three weeks with the idea of preventing the occurrence of thyroidism.

In this connection it would appear an amazing proposition that the great majority of water consumers who are doubtless free from goitrous affections should have to drink an iodised water in order to benefit the few who are not so happily placed. The obvious conclusions being that the iodine treatment should be limited to the actual sufferers, but this feeling of hostility is hardly justifiable.

In the first place, it must be noted that it is not the actual cases that it is sought to cure, but the possible sufferers, in other words it is an attempt to prevent the development of the affection in those who otherwise would not escape, and as it is impossible to diagnose in the case of children and young adults which are and which are not destined to be affected, the experiment aims at safeguarding the interests of the few by treating the whole water supply with iodine.

Secondly, the dose is very minute, viz.: 16.6 pounds to 25,000,000 (U. S.) gallons or 0.008 pound per 100,000 pounds (= 10,000 imperial gallons) and with this dosage no danger to health would seem to be possible either to the potential sufferers or to those who have no need of the treatment.

Thirdly, it has been known for years that a deficiency of iodine is the best, if not the only satisfactory explanation of the cause of ordinary goiter.

Water has been blamed at one time or another for most of the ills of suffering humanity including thyroidism. Pure and impure, hard and soft, and generally waters of quite dissimilar qualities have been thought to be a contributory cause. There is not appar-

[1] From the Chemical Laboratories of the Royal Institute of Public Health. The Journal of State Medicine, vol. 34, No. 1, January, 1926, page 59.

ently any combination of water supplies peculiar to goitrous districts throughout the world which throws any definite light on this obscure problem. The consensus of opinion, however, is in favour of iodine as a prophylactic, although, the manner of introduction of the drug is a matter for serious concern. Much depends on the incidence of the disease, and what may be permissible or desirable at one place may be unjustifiable at others. It is now no longer held that the hardness of water is connected with goiter.

Several difficulties may present themselves in the wholesale application of iodine to water supplies.

People drink very variable amounts of water and so would ingest very varying amounts of iodine. If the proportion of iodine in the water is kept too low the dose may be insufficient to produce the desired effect, unless an undesirable or impossible volume of water is consumed. There are also conditions of thyroid disease associated with enlargements of the gland in which such treatment with iodine is directly contra-indicated.

While the amount of iodine suggested to be added is extremely small it may however be questioned, if the ingestion of minute quantities of iodine compounds has so powerful an action that it will prevent the development of the disease in those prone to it, whether in the healthy body, which does not need such an addition, the possibility of a disease of a contrary nature might not be set up.

Even in districts where thyroid enlargements are particularly common the number of sufferers would only be a minority of the population, and it may be questioned whether it is right to submit the whole population to a regime serviceable to this minority only.

Consequently any form of medicinal treatment applied promiscuously must be carefully watched less there be a danger to the community at large.

Before sanctioning the addition of iodised water on a large scale irrefutable proof must be produced that it is harmless to the healthy.

While it is true that an intake of iodine compound is essential for life, it is also true that the iodine ingested normally is not in the form of a simple chemical compound (such as sodium iodide), but composed of highly complex organic substances, and it is probable that the body may be capable of regulating the intake of these substances in the form with which it has learnt to deal with them, and yet not be capable of regulating its supply from chemical compounds unfamiliar to it.

The use of iodine containing substances for goitrous affections dates back hundreds of years. Some thirty years ago iodine was shown to be normally a constituent of the thyroid gland, and it is now fairly generally agreed that if the store of iodine falls below 0.1 per cent of the total amount of dried gland tissue, hypertrophic and other changes are liable to occur.

Although it seems likely, if not certain, that the wastage is due primarily to a deficiency of iodine in liquid or solid foodstuffs or accessories it may be true that the gland in some way conserves its store, provided no toxic factor is introduced to upset the equilibrium of its normal working.

Although the artificial exhibition of iodine has been shown to be a prophylactic measure of some value, this does not necessarily prove that the essential cause of thyroidism is solely due to a deficiency or absence of iodine in the diet. It may only mean that when certain mysterious states of toxicity exist, the only way to prevent the sustained loss of iodine is to counteract the loss by sustained ingestion.

As regards methods of iodine administration, inhalation and external application are unsatisfactory as compared with internal administration. In the Akron (Ohio) schools, 3 grain doses of sodium iodide were given in the drinking water once a day for two weeks in the spring and again in the autumn. The Swiss authorities favor the use of iodine and chocolate tablets, throughout the entire country, the Austrian authorities advocate the use of iodised salt.

At Rochester, as indicated previously, water is iodised, and as people drink very variable amounts of water, so in practice differing amounts of iodine would be ingested. The dose of sodium iodide given in the British Pharmacopoeia is 5 to 20 grains, but very much smaller doses suffice apparently for thyroid prophylactic treatment. The Rochester dose amounts to 0.056 grains of sodium iodide per gallon of water. If the dose be materially increased there is possibly some danger of heavy water drinkers receiving too much iodine, and it cannot be denied that in certain hypersusceptible persons, iodine would seem to be actually contra-indicated.

The Rochester experiments cannot be ignored, and if any risks exist they can easily be greatly exaggerated, and if there are no tangible risks it would seem the exhibition of iodine by the water supply is the only practical way potential sufferers from thyroidism can be required to undergo treatment with a drug which the consensus of opinion agrees is of definite prophylactic importance.

DISCUSSION

STANDARDIZATION OF CAST IRON PIPE

A standardization project of far-reaching importance is about to be inaugurated through the formation of a representative Committee on Cast Iron Pipe which will undertake a general program of unifying existing specifications for cast iron pipe into a consistent set of nationally recognized specifications. This committee, which will be officially known as the Sectional Committee on Standard Specifications for Cast Iron Pipe, is being sponsored by the American Gas Association, American Society for Testing Materials, American Water Works Association and New England Water Works Association and will function under the procedure of the American Engineering Standards Committee.

This development is the outcome of the submission two years ago by the American Gas Association of its Standard Specifications for Cast Iron Pipe and Special Castings to the American Engineering Standards Committee for their approval as American Standard Specifications. It became evident that consideration of these specifications for such approval would involve the standardization of cast iron pipe in general, and at a conference held under the auspices of the American Engineering Standards Committee, which was very widely representative of industries that produce and use this product, it became clear that whereas dimensional standardization was principally involved in the specifications for gas pipe, a broader treatment of the whole problem was essential if results of the greatest benefit were to be obtained. Thus at this conference the need of a study of the quality of metal in cast iron pipe and the problem of suitable coatings were emphasized as ones of primary importance to water works engineers. Recently developed methods of producing cast iron pipe must be taken into consideration. The American Gas Association was entirely willing to have the project broadened, and upon the recommendation of the conference the American Engineering Standards Committee agreed to set up a broad program of standardization of cast iron pipe under its auspices and invited the American Gas Association, American Society for Testing Materials, American

Water Works Association and New England Water Works Association to sponsor the organization of a representative "sectional committee" to carry on the actual work of investigation and standardization.

The scope of the work has been defined as follows:

> Unification of specifications for cast iron pipe, including materials; dimensions; pressure ratings; methods of manufacture (including such new developments as centrifugal casting), in so far as they may be necessary to secure satisfactory specifications; elimination of unnecessary sizes and varieties; consideration of the possibility of developing a coördinated scheme of metallic pipe and fittings applicable to all common mediums; and methods of making up joints in so far as they are determining as to the dimensional design of cast iron pipe.
>
> The types of cast iron pipe to include: bell and spigot pipe; flanged pipe; flanged and bell mouth fittings and wall castings; pipe elbows, tees, Y's, return bends, and other fittings not now included in standard lists; cast iron pipe threaded for flanges or couplings; soil pipe and other light types of cast iron pipe and fittings. The standardization is not to include methods of installing pipe and similar matters, except as to the making up of joints in its relationship to the dimensional standardization of pipe and fittings, as noted above.

The sponsors have been engaged in the details of organizing the sectional committee, which will comprise representative producers and users of cast iron pipe, and independent technical experts. Eleven technical societies and associations are represented in the work of the committee. This stage of the work is practically completed and the sponsors announce below the personnel of the committee.

The formation of this committee brings together for the first time the major technical societies interested in the various phases of the cast iron pipe problem and it is confidently anticipated that the cooperation of the producers and consumers upon the broad basis thus made possible will result in the development of national standards of quality and dimensions acceptable to all.

Plans for the formal organization of the committee in the near future are being made and will shortly be announced.

Submitted by AMERICAN SOCIETY FOR TESTING MATERIALS,
C. L. WARWICK, *Secretary-Treasurer.*

Personnel of Sectional Committee on Specifications for Cast Iron Pipe
American Gas Association

Walton Forstall, Engr. of Distribution, United Gas Improvement Co., Philadelphia, Pa.

H. E. Bates, Asst. Ch. Engr., Peoples Gas, Light and Coke Co., Chicago, Ill.

C. C. Simpson, Jr., Gen. Supt., Dept. Mains and Services, Consolidated Gas Co., N. Y. C.

American Railway Engineering Association

C. R. Knowles, Supt., Water Service, Illinois Central Railroad, Chicago, Ill.

Alternate:

C. P. Van Gundy, Water Engineer, Baltimore and Ohio Railroad, Baltimore, Md.

American Society of Civil Engineers

F. H. Stephenson, Asst. Supt., Detroit Dept. of Water Supplies, Detroit, Mich.

American Society of Mechanical Engineers

J. E. Gibson, Mgr. and Engr., Commissioners of Public Works, Charleston, S. C.

American Water Works Association

Thos. H. Wiggin, Consulting Engr., 415 Lexington Ave., New York City.

Wm. H. Brush, Deputy Chief Engr., Dept. Water Supply, Gas and Elec., Municipal Building, New York City.

W. C. Hawley, Chief Engr. and Gen. Supt., Pennsylvania Water Co., Wilkinsburg, Pa.

E. E. Wall, Water Commissioner, 312 City Hall, St. Louis, Mo.

F. A. Barbour, Hydraulic and San. Engr., Tremont Building, Boston, Mass.

National Fire Protection Association

C. W. Mowry, Director, Factory Mutual Laboratories, Boston, Mass.

U. S. Bureau of Standards

I. J. Fairchild, Bureau of Standards, Washington, D. C.

Underwriters' Laboratories

A. W. Claussen, Asst. Engr., Underwriters' Laboratories, Chicago, Ill.

American Society for Testing Materials

Richard Moldenke, Consulting Metallurgist, Watchung, N. J.

S. R. Church, Technical Adviser, The Barrett Co., New York City.

New England Water Works Association

F. A. McInnes, Consulting Engr., Boston, Mass.

C. W. Sherman, Consulting Engr., Boston, Mass.

W. R. Conard, Burlington, N. J.

Manufacturers Standardization Society of the Valve and Fittings Industry

C. R. Wood, 400 Chestnut St., Phila., Pa.

American Cast Iron Pipe Co.

W. D. Moore, President, Birmingham, Alabama.

J. B. Clow and Sons

Kent S. Clow, Vice-President, Chicago, Ill.

Glamorgan Pipe and Foundry Co.

A. M. Campbell, Lynchburg, Va.

Lynchburg Foundry Co.

W. G. Hammerstrom, Lynchburg, Va.

National Cast Iron Pipe Co.
A. M. Ford, Asst. Engr., Birmingham, Ala.
R. D. Wood and Co.
Walter Wood, 400 Chestnut Street, Phila., Pa.
Warren Foundry and Machine Co.
Shellman B. Brown, Supt., Phillipsburg, N. J.
U. S. Cast Iron Pipe and Foundry Co.
N. F. S. Russell, Pres., Burlington, N. J.
D. P. Hopkins, Vice-Pres., Burlington, N. J.
D. B. Stokes, Gen. Sales Mgr., Burlington, N. J.

WILLIAM THOMPSON SEDGWICK MEMORIAL

In recognition and perpetuation of the services and ideals of Professor W. T. Sedgwick and in love for the man, his friends desire to create a permanent remembrance. A group of these friends began the accumulation of a fund for the permanent endowment of a Sedgwick Memorial Lectureship. The lectures are to be given at least once a year upon some subject in biology or public health. The three lectures in this series to date have been given by E. B. Wilson, W. H. Welch and W. J. V. Osterhout.

A second group of friends have met and formulated plans for a Sedgwick Memorial Medal to be awarded not oftener than once a year for distinguished service in public health. This plan was laid before the Governing Council of the American Public Health Association and through this body the Association voted to accept the responsibility for administering the funds and awarding the medal through an appropriate committee.

There are already some funds on hand for these projects. A further sum of $15,000 is needed to place both endowments on a permanent basis. The Committees feel that friends and admirers of Professor Sedgwick will desire to make a contribution to this fund. It is possible to give to either project or to designate the division of one's contribution if so desired. If no division is indicated gifts will be equally divided in support of both of undertakings.

Subscriptions should be forwarded to William Thompson Sedgwick Memorial Fund, 370 Seventh Ave., New York City.

REGULATIONS ON CROSS CONNECTIONS—NEW YORK STATE DEPARTMENT OF HEALTH

At a meeting of the Public Health Council held November 12, 1925, Chapter VII of the Sanitary Code[1] was amended by adding

[1] The State Sanitary Code does not apply to New York City.—*Editor.*

thereto three new regulations to be known as Regulations 15-a, 15-b and 15-c, to take effect July 1, 1926, and to read as follows:

SANITARY CODE—CHAPTER VII

MISCELLANEOUS

Regulation 15-a. Certain cross-connections between water supplies not permitted. No officer, board, corporation or other person or group of persons, owning or having the management or control of any potable water supply furnished to any municipality or water district, shall permit after July 1, 1926, any physical connection between the distribution system of such supply and that of any other water supply, unless such other water supply is regularly examined as to its quality by those in charge of the potable water supply to which the connection is made and is also found to be potable. This prohibition shall apply to all water distribution systems either inside or outside of any building or buildings.

Provided, that, where such physical connections now include two gate valves with indicator posts, two check valves of the Special Factory Mutual Fire Insurance design or equivalent with drip cocks and gauges for testing, all located in a vault of water-tight construction accessible for ready inspection, the date of discontinuance may be extended until July 1, 1928.

Regulation 15-b. Permissible arrangements where dual supplies are used. If a potable water supply is used as an auxiliary supply delivered to an elevated tank or to a suction tank, which tank is also supplied with water from a source with which cross-connections are not permitted by regulation 15-a, such tank shall be open to atmospheric pressure and the potable water supply shall be discharged at an elevation above the high water line of the tank.

Regulation 15-c. Non-potable water in industrial plants to be rendered unavailable for drinking. Wherever a potable public water supply is available, no other supply shall be used or rendered available for drinking and for other personal or domestic purposes in any industrial plant, unless such other supply is approved by the local health officer. If no such public water supply is available, the water for drinking or for other domestic purposes shall be of safe, sanitary quality approved by the local health officer. If the water supply for industrial or fire protection purposes is obtained entirely or in part from a source not approved for drinking purposes, this supply shall be distributed through an independent piping system having no connection with the systems for drinking and for other domestic use, and the outlets shall be so arranged as to be inaccessible for drinking.

SOCIETY AFFAIRS

4-STATES SECTION

The 4-States Section had a luncheon at the Bellevue-Stratford Hotel, on Thursday, December 17, 1925.

After the luncheon was over, there was an informal meeting presided over by Carleton E. Davis, former President of the Section.

A paper was read by S. M. Van Loan, of the Philadelphia Water Department, concerning the work of his department during subway construction.[1]

After the reading of the paper a few remarks were made by H. F. Huy, President of the Association, and B. C. Little, Secretary.

Following these remarks, an able discussion of Mr. Van Loan's paper was carried on by W. W. Brush, who gave some of his personal experiences with the work in New York City and V. B. Siems. Mr. McCaleb, President of the Pennsylvania Water Works Association, also made a short address.

IOWA SECTION

The eleventh annual meeting of the Iowa Section, was called to order by Chairman Max Levine at the Hotel Julien, Dubuque, at 10:20 a.m., Tuesday, December 2. C. E. Douglas, City Manager of Dubuque, welcomed the Section to the city on behalf of Mayor Alberson, who was unable to attend on account of sickness. Chairman Levine responded to Mr. Douglas's address. Thirty seven members were present.

The New Manual of Water Works Practice of the American Water Works Association, was discussed by Jack J. Hinman, Jr., Arthur T. Luce, J. W. McEvoy, Joseph W. Straub, Frank Lawlor, R. H. Holbrook and C. R. Knowles.

The Flushing of Water Mains was discussed by Frank Lawlor, William Molis, J. W. McEvoy, John W. Pray, J. C. Jensen, Arthur T. Luce, C. D. Hays, H. C. Hawkins, E. D. Brown, and Thomas J. Skinker.

[1] Journal, March, 1926, page 288.

Algae Troubles During the Past Summer, was discussed by Jack J. Hinman, Jr,. Max Levine, J. W. McEvoy, C. D. Hays and R. H. Holbrook.

The meeting adjourned at 12:00 noon.

The Section reconvened at 2:00 p.m. and listened to the reading of papers, as folows:

1. "A New Water Supply for the City of Oneida, New York," by Dr. Nicholas Knight, Professor of Chemistry, Cornell College, Mount Vernon, Iowa.

2. "Softened Water for Industrial and Municipal Use," by Mr. W. D. Collins, Chemist in Charge, Quality of Water Division, United States Geological Survey, Washington, D. C. Discussed by L. I. Birdsall, R. H. Holbrook, C. R. Knowles, A. T. Luce, Paul C. Laux and J. P. Hanley.

3. "The Cause and Prevention of Red Water,"[2] by Paul C. Laux, National Lime Association, Chicago, Illinois. Discussed by L. I. Birdsall, J. P. Hanley, C. O. Bates and R. H. Holbrook.

A fifteen minute recess was taken at this point, after which the members of the Section resumed the further discussion of Round Table topics.

"Auxiliaries for Steam Operation of Pumping Plants" was discussed by A. T. Luce, P. F. Hopkins and H. F. Blomquist.

"How Often Should Coagulation Basins Be Cleaned," was discussed by L. I. Birdsall, F. G. Gilkison, Frank Lawlor, J. P. Hanley, J. C. Jensen and H. F. Blomquist.

The session ajourned at 4:50 p.m.

A special dinner was held in the dining room of the Julien Dubuque Hotel at 6:00. At 8:00 p.m. the public meeting, which was scheduled on the program for the Chamber of Commerce rooms, was opened in a special room provided at the Julien Dubuque Hotel. There was an attendance of about eighty-five, the greater number of whom were those in regular attendance at the meeting, and from out of the city. The following papers were given:

1. "Keeping the Water Works Working," Charles R. Henderson.

2. "Water and Health," Don M. Griswold, State Commissioner of Health, Des Moines, Iowa.

3. "The Need for Water Supply Data,"[3] N. G. Grover, Chief Hydraulic Engineer, United States Geological Survey, Washington, D. C.

[2] Journal, March, 1926, page 271.

[3] This Journal, page 400.

The session adjourned at about 10:00 p.m.

The Tuesday morning meeting was opened by Chairman Levine at 9:40 a.m. with fifty-six members and guests present. Papers were read as follows.

1. "Water Softening by the Hot Process, With and Without the Use of Alum." A. M. Buswell. Discussed by C. R. Knowles and C. O. Bates.

2. "The Rehabilitation of the Marshalltown Water Works," Arthur T. Luce, Discussed by A. M. Buswell, P. F. Hopkins, G. C. Habermeyer, and G. F. Gilkison.

(At this point Chairman Levine turned the chair over to Vice Chairman, H. V. Knouse, of Omaha, Nebraska.)

3. "Laboratory Control of the Chemical Treatment of Missouri River Water," Kenneth C. Armstrong, discussed by A. M. Buswell, W. A. Kivell, G. F. Gilkison, H. V. Knouse, L. I. Birdsall and C. R. Knowles.

4. "Ground Water Resources of Illinois,"[4] G. C. Habermeyer, discussed by L. I. Birdsall, J. P. Hanley and C. R. Knowles.

The following committees were appointed by Chairman Levine to report at the business session during the afternoon:

Nominating Committee: Charles R. Henderson, Chairman, William Molis and C. D. Hays.

Resolutions Committee: Frank Lawlor, Chairman, R. H. Holbrook and Thomas J. Skinner.

Auditing Committee: E. B. Black, Chairman, and L. L. Hezzelwood.

The session adjourned at 12:30 p.m.

The session reconvened at 2:00 p.m. and proceeded to the reading of papers as follows:

1. "Water Supply Conditions in Missouri" by Geo. W. Putnam. Discussed by C. O. Bates, H. V. Pedersen, H. V. Knouse, G. F. Gilkison, L. I. Birdsall, R. H. Holbrook and J. P. Hanley.

2. "The Determination of Dissolved Oxygen and Biochemical Oxygen Demand in Studies of Stream Waters" by Jess M. Holderby, Discussed by C. O. Bates, H. V. Pedersen and Max Levine.

3. "The Pollution of Streams by Wastes from Canneries and Dairies in Iowa" by John H. Buchanan, Associate Professor of Sanitary Chemistry, Iowa State College, Ames, Iowa. Discussed by Max Levine.

[4] Journal, March, 1926, page 234.

4. "Laying Cast Iron Mains"[5] by Homer V. Knouse, Discussed by C. R. Knowles.

5. "Financial Reports of Water Works Operation" by H. F. Blomquist, discussed by Max Levine and A. T. Luce.

The paper entitled "Placarding Public Water Supplies on Tourist Highways" by Earl L. Waterman was read by title in the absence of the author.

The Section then went into business session. The nominating committee brought in the following ticket:

For Chairman, Homer V. Knouse.

For Vice Chairman, J. W. McEvoy.

For Directors: Thos. J. Skinker, C. D. Hayes.

The ticket as presented was unanimously elected.

The resolutions committee brought in the following resolutions:

1. "The Iowa Section of the American Water Works Association in convention assembled at Dubuque, Iowa, requests all members of the Section to call the attention of the Members of Congress to the injustice of compelling employees of Municipal Water Departments to pay the federal income tax, when all other municipal officers and employees are exempt therefrom."

2. "*Be it Resolved:* That the Iowa Section of the American Water Works Association extends its thanks to Don. M. Griswold, A. M. Buswell, N. C. Grover, W. D. Collins, J. M. Holderby, P. C. Laux, Nicholas Knight, J. H. Buchanan, and G. C. Habermeyer for their contribution to the program of the Iowa Section."

3. "*Resolved:* That the Iowa Section of the American Water Works Association extends its thanks to the City of Dubuque, to its Council, City Manager, City Solicitor, and Water Board for the assistance and encouragement offered the members of the Section in connection with the eleventh annual meeting."

4. "*Resolved:* That the Iowa Section of the American Water Works Association extends it special thanks to J. W. McEvoy, Superintendent of the Water Works, Dubuque, Iowa, for his efforts and his work in making the eleventh annual meeting of the Section a success."

5. "*Resolved:* That the Iowa Section expresses its regrets at the fact that Dr. James Alberson, Mayor of Dubuque, was unable to be present at the meeting and address the Section as originally planned. And be it further resolved that the Section express to Mayor Alberson its sincere wishes for his speedy recovery from his injury."

6. "*Be It Resolved:* That the Iowa Section of the American Water Works Association express its appreciation to the management of the Hotel Julien Dubuque for courtesies extended in connection with the eleventh annual meeting of the Section."

7. "*Be it Resolved* by the Iowa Section of the American Water Works Association that stream pollution studies along the line outlined by Don M.

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[5] Journal, February, 1926, page 129.

Griswold in his address before the Section are necessary to the public good, and that the intensive conduct of the studies initiated on the Iowa rivers should be continued for the protection of our streams and for the furtherance of and the safeguarding of the public health."

8. "*Be it Resolved* by the Iowa Section of the American Water Works Association that the publication recently produced by the Standardardization Council of the Association under the Chairmanship of George W. Fuller, is heartily endorsed as a suitable Manual of Water Works Practice, and that it is recommended to the careful study of the membership of the Section and all other persons who are interested in the economical and efficient operation of water works plants."

The Auditing Committee, by E. B. Black, Chairman, reported that they had examined the books of the Secretary-Treasurer and found them correct.

The session then adjourned at 5:30 p.m.

At 6:00 p.m., the entertainment and dinner given by the manufacturers' agents took place. The members of the Section enjoyed an excellent dinner and an interesting program of songs and other specialities which had been provided. The appreciation of the Section was recorded by means of a vote.

On Friday morning Chairman Levine called the Section to order at 10:00. The following talks were given:

1. "Coöperation of City Water Department With Health Department Under City Manager Form of Government," by Dr. D. C. Steelsmith, Health Officer, City and County of Dubuque, Dubuque, Iowa. Discussed by H. F. Blomquist, Jack J. Hinman, Jr., Max Levine and C. O. Bates.

(At this point Dr. Levine turned the chair over to Homer V. Knouse.)

2. "The City Manager Plan at Dubuque" by M. H. Czizek, City Solicitor, Dubuque, Iowa. Discussed by P. F. Hopkins and Max Levine.

3. "The History and Present Situation of the Dubuque Water Works System," by J. W. McEvoy, Discussed by H. F. Blomquist, George E. Shoemaker, P. F. Hopkins and Homer V. Knouse.

Topic Number Eight of the Round Table Discussion, "Proper Spacing of Fire Hydrants"[6] was discussed by F. H. King, P. F. Hopkins, William Molis, Homer V. Knouse, Frank Lawlor, and H. F. Blomquist.

W. W. DeBerard told the Section of the desire of the Chicago

[6] Journal, March, 1926, page 224.

members that the 1927 meeting of the American Water Works Association be held in Chicago. Desirability of such a meeting in connection with the water works situation in Chicago was discussed by several members. It was moved by H. V. Knouse, seconded by Frank Lawlor, that it was the sense of the Iowa Section meeting that the 1927 meeting of the American Water Works Association should be held in Chicago, and that the Secretary of the Iowa Section should be instructed to notify the Secretary of the Association and the Convention Committee of that body concerning this matter. The motion was carried.

The meeting adjourned at 12:25 p.m.

In the afternoon the members of the Section were taken to see the various parts of the Dubuque water supply system. The parties were conducted by J. W. McEvoy, the Superintendent of the Water Plant. The cars used were furnished by the Chamber of Commerce of Dubuque. Unfavorable weather conditions prevented the seeing of the beautiful scenery on the bluffs of the Mississippi to the best advantage. This was disappointing to the members of the Section and to the local committee. One hundred and one members and guests attended the meetings.

ABSTRACTS OF WATER WORKS LITERATURE

FRANK HANNAN

Key: American Journal of Public Health, **12**: 1, 16, January, 1922. The figure 12 refers to the volume, 1 to the number of the issue, and 16 to the page of the Journal.

Iron Incrustation in Water Pipes: the Responsibility of Iron Algae. DAVID ELLIS. Water and Water Eng., **27**: 352–354, 1925. Hard nodules found in water pipe were separated from pipe wall by tar coating giving impression that material came from water rather than from pipe and was probably due to algae. Although the organisms were present and iron sufficient for their growth was contained in the water, formation of nodules in this way could not be demonstrated. Tar coating was found pervious to water and iron came from pipe. Soft slimy deposits may be due to bacteria and iron from water. Ellis has never found hard nodules in wood pipe.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Venturi Flume and Effect of Contractions in Open Channels. ALEX. H. JAMESON. Water and Water Eng., **27**: 271–273, 1925.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Silting of the Modder River. JOHN A. CASKIE. Water and Water Eng., **27**: 354–355, 1925. Storage capacity for Bloemfontein water supply is seriously reduced due to silting. Attempts have been made to remove much of silt by increasing velocity during flood times.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Bacteriological Purification of Drinking Water with Alkaline Hypochlorites and Liquid Chlorine. D. F. RICART. Memorial de Ingenieros del Ejercito, November, 1924. General and comprehensive paper dealing with permanent and military installations.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Lucknow Water Supply. Anon. Water and Water Eng., **27**: 263, 1925. Purification equipment consists of 3 m.g.d. Patterson rapid sand filters and old (slow sand?) filters. Maximum daily capacity is about 9 m.g.d.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Chesterfield, England, New Water Works. CHAS. BOLDRY. Water and Water Eng., **27**: 257–263, 1925. Engineering description of ground water project to supplement existing gravity surface supply.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Preparation of Endo's Medium. NORMAN MCL. HARRIS. Military Surgeon, **57**: 280, 1925. Levine's formula does away with meat extract which is a bothersome substance. Basic fuchsine contains rosaniline and pararosaniline. Other fuchsines are irregular. Hydrogen ion concentration of 7.4 to 7.6 is best. Any peptone which will give good result in Levine's formula is satisfactory. Formula: K_2HPO_4 3.5 grams; Difco Peptone 10 grams; washed and dried agar 15 grams; lactose C.P. 10 grams; distilled water 1000 grams. To each 100 cc. of above add Na_2SO_3 anhydrous 0.25 gram; basic fuchsine (containing rosaniline and parasrosaniline) 10 per cent filtered alcoholic solution, 3.5 cc.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Goiter and Drinking Water. GERALD M. FLOOD. Water and Water Eng., **27**: 54–55, 1925. Considers that actual cause of goiter is bacterial and that it is spread by sewage polluted waters.—*Jack. J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

A California Oil Well (Deep Record). Anon. Science, **62**: 366, 1925. Statement based on report of Dr. F. P. VICKERY regarding Miley Oil Co's No. 6 well at Athens, Los Angeles County, California. Oil was produced at 7591 feet. Well has following records: (1) 7591 feet, deepest hole ever drilled. (2) Deepest oil well. (3) Landed 41-inch casing at 7591 feet. Longest casing. (4) Cemented through perforations at 7305 feet. (5) Took formation cores at 7570 feet and recovered perfect samples of good oil sand. Drilled with rotary tools in 230 working days, averaging 33 feet per day. Cost of drilling, labor, and material $21.60 per foot or $164,000. Producing 150 bbls. 37°Be. oil with 20 per cent salt water. Gas lift is used as pumping at the necessary depth was not considered practical.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Taste Factor in Drinking Water. Lancet, July 11, 1925, pp. 76–77. Two kinds of tastes likely to be found in city water; (1) chlorinous, (2) iodoform. That of iodoform can be produced by 1 part of phenol in 1000 million parts of water. There is sufficient phenol in air of large towns to supply this amount. Chief taste preventers are organic matter, $KMnO_4$, and NH_4 compounds. Filtration after chlorination might reduce taste. Particulars are given of cost of treatment for taste removal by Sir A. C. HOUSTON.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Mechanically Slaked Lime, an Important Product for Water Softening. Anon. Water and Water Eng., **27**: 209, 1925. Irregularity of composition of CaO due to air slaking, stone, grit, etc., makes it more difficult to use than mechanically slaked lime. Latter increases 30 per cent in weight on slaking, but free moisture is less than 0.25 per cent. More accurate dosing is possible. Cost is slightly higher due to process, bagging, etc. There is no wastage.—*Jack H. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Causes of the Appearance and Diffusion of Cholera: the Rôle of Carriers of Germs and the Results of Preventive Vaccination. POTTEVIN and ABT. Bul. mens. office internat d'hyg. publ., **17**: 864–896, 1925. Water borne epi-

demics are exceptions. Merchandise, except green vegetables, is not incriminated. Carriers are important. Bibliography of 85 titles.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Supervision Over the Safety of Chicago's Water Supply. ARTHUR E. GORMAN, Proc. Ills. Eng. Soc., **40**: 57–63, 1925. Water is obtained through six cribs in Lake Michigan 2 to 4 miles from shore. Calumet river is chief source of contamination. Backing up of Chicago river occasional menace. Dumping of dredged materials into lake for fill and sewage from lake vessels also important. Hourly tests for free chlorine are made to check adequacy of treatment at each station. 3000 pounds liquid Cl are applied to 800 million gallons on daily average.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Pulverized Coal as Applied to the Steam Boiler Plant. W. E. EAST, Proc. Illinois Eng. Soc., **40**: 75–80, 1925. First used in 1899 in cement industry, but not successfully applied to steam boilers till 1916 at Parsons, Kan., plant of M. K. T. Ry. First central station use at plant of Milwaukee Elect. Ry. and Light Co. Present specifications require 65 per cent of coal to pass 200 mesh sieve. Formerly finer grinding was required. Formerly thought it was necessary to dry coal to 1 per cent moisture, but now dry only to 5 to 8 per cent moisture. Lignite containing 24 per cent moisture will be used at Denver. Advantages: (1) high boiler efficiency, (2) ability to burn high and low grade fuels with approximately same efficiency, (3) ability to burn liquid, solid, or gaseous fuel in same furnace, (4) low banking and stand-by losses, (5) ability to carry high overloads for long periods, (6) ease of adapting to automatic control.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

A Water-Borne Typhoid Epidemic at Aegion, Greece. GEORGE SP. JOANNIDES. La Grèce medicale, **27**: 10, 1925; Bul. mens. office internat. d'hyg. publ., **17**: 907–908, 1925. An epidemic of 128 cases and 2 deaths in November 1924. Water of aqueduct was polluted at point of entrance to reservoirs. Distribution of water was stopped, repairs made, and reservoirs treated with lime. Prophylaxis by hypodermic injection having been refused, the vaccine (1,200 millions B. typhosus, 600 millions each of para A and B per cc.) was administered before breakfast on three consecutive days in doses of 30 drops. None of those treated developed the disease.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Observations on the Working of Slow Sand Filters. V. GOVINDA RAJU, Water and Water Eng., **27**: 350–352, 1925. Custom of wasting water from maturing filters is very wasteful, since water could be chlorinated and used. Resanded beds which give bad water for a time after resanding could receive chlorinated raw water and effluent could be used. There is no deterioration of quality of effluent with high loss of head provided violent fluctuation of rate of filtration does not occur. In Bengal life of filter is too short (2–6 wks.) Chlorination of raw water and suppression of algae should prolong use. Filters usually operate much slower than necessary. A drop of 2 inches per hour was noted when 4 inches would have been better. Wasteful regulation of

settling basins is common. Chlorination of raw water applied to slow sand filters is to be preferred to chlorination of filtered water.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Is Stream Pollution Necessary? C. M. Baker, Proc. Eng. Soc. Wis., **17**: 77–84, 1925. It is not feasible to do away with stream pollution entirely under present civic and industrial conditions, but it should be controlled and kept within reasonable limits.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Deep Well Pumping. Leon A. Smith. Proc. Eng. Soc. Wis., **17**: 86–92, 1925 Pumping experience at Madison, Wis. Recommendations: (1) If suction lift is less than 20 feet under maximum pumping, pump by suction. (2) If group of wells is to be pumped and extreme distance between wells is 6000 feet or less and total lift less than 200 feet, use an air lift and central compressor station. (3) If an individual well is to be pumped directly into mains use an electrically driven deep well pump provided storage is ample and size of well permits pump installation. If storage capacity is not available a gasoline engine or other standby unit is advisable. In each case consideration should be given all methods.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Report on the Installation of Sewers and the Propagation of Worm Infestations in British Guinea. H. Khalil. J. Helminthology, **2**: 175–190, 1924; Sanitation Supplement, Tropical Disease Bulletin, **1**: 45, Mar. 1925; Bul. mens. office internat. d'hyg. publique, **17**: 1014–1016, 1925. In England and Europe most thought is given to bacterial content of sewage and waters. Worms, including hookworm, and protozoa are very important in tropics. Hookworm larvae can pass through filter paper and through the human skin. Filtration is probably not effective against them. Septic tank action does not always kill hookworm larvae.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Welded Steel Pipe Protected Inside and Out by Reinforced Concrete. A. Bonna. La Technique Sanitaire, **20**: 80–88, 1925.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Supplying the Communes of the Canton of Vaud, Switzerland, with Potable Water. Roux. La Technique Sanitaire, **20**: 88, 1925. Out of 388 communes, all but 62 are served by public water supplies.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Cemeteries and Cremation. Fr. Messerli. La Technique Sanitaire, **20**: 65–71, 1925. Discusses decomposition of cadavers and relation to nature of soil of burying ground, ground water height, and hygiene. Cremation is favored on ground of economy as well as on that of hygiene.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The conduits for supplying potable water to the cities of Flanders and the Belgian coast, Le genie civil, Sept. 20, 1924; La Technique Sanitaire, **20**: 97–98, 1925. Water derived from carboniferous limestones south of Liège by

galleries 1.95 m. x 0.9 m. x 4 km. with large zone of protection is carried to a large number of Belgian communities by a conduit 51 km. long, of which 25 km. is in tunnel, 17 km. in trench and 9 km. in siphons.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Société Nacionale des Distributions d'Eau de Belgique, Its Purpose Duty, Organization and Operation. HACHEZ. La Technique Sanitaire, **20**: 127–131, 1925. A coöperative intercommunal association established by law in 1913 in which the nation takes a part, provides part of the capital, and names one half the board of direction and the director general. The constituting act is reprinted.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Report on the Water Softening and Purification Works for the Year 1924. CHAS. P. HOOVER. Supplement to the City Bulletin, Columbus, Ohio, 1924, 29–38. Hardness of water of Scioto River was reduced from average of 299 p.p.m. to 99 p.p.m. Raw water was 10 per cent harder than average for last 16 years. Lime, soda ash, alum and Cl were the chemicals employed in treatment. 8700 million gallons were treated at a cost for chemicals of $20.81 per million gallons.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Seventeenth Annual Report of the Division of Sewage Disposal. C. D. MCGUIRE. Supplement to City Bulletin, Columbus, Ohio, 1924, 39–43. Operation of sprinkling filters was not necessary until July on account of rains and high water. During the year 4571 million gallons of sewage were treated. The dose on the filters was at the rate of 2.64 m.g.d. The mean dosage was 4.57 m.g.d. and the filters were in service 58 per cent of the time. The imhoff tanks removed 96 per cent by volume of the settleable solids and 60.6 per cent of the total suspended solids. The detention period was 4.6 hours. The consumption of dissolved O was reduced 38.5 per cent by the tanks. The filters removed 23 per cent of the suspended solids of the tank effluent and decreased the consumption of dissolved O 77 per cent and produced 3.4 p.p.m. N as NO_2 and NO_3 in effluent. The whole system removed 69.7 per cent of the total suspended solids and reduced the consumption of dissolved O 85.7 per cent. Wet sludge is produced to amount of 7.6 cubic yards per million gallons, or 2.6 cubic yards per million gallons on dry basis. Filters were designed for 20 m.g. per day but are now handling a maximum of 37.5 m.g.—*Jack J. Hinman, Jr.*

Swimming Pools. WESLEY BINTZ. Playground, **19**: 259–262, 1925. Maximum daily attendance in average town is about 7 per cent of population, and maximum attendance at one time is 2 per cent. Recommends round or oval pool on account of less length of wall and lessened temperature stresses as compared to rectangular pool. Footings at least 3 feet below ground surface and sub-drainage are necessary in order to prevent frost damage. Average pool is about 60 per cent wadable, but larger area of shallow water is desirable. Length rather than too great width is advantageous in designing pool of definite area. This assists guards. Overhead lights are required to assist life guards, if pool is to be opened at night.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Safe Water for the Highways. Anon. Public Health (Michigan), **3**:1 306–308, 1925. Details of work of State Health Department in 1925. Three types of signs were posted; one was a large sign advising use of approved water supplies; other two were for individual supply, noting its character. Sign for unsafe sources was in red and white, for others, gray and black.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Economics Resulting from the Rational Use of Conduits in Cast Iron, Steel, and in Reinforced Concrete for Transporting Water and Gas. J. GILBERT, La Technique Sanitaire, **20**: 187–195 and 209–214, 1925. Dangers of leakage into and from water mains and of collection of escaped gas under pavements are discussed. Considerable space is given to various classes of joints, especially one designed by the author.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Purification of Water Supplies on Field Service, as Retrospect. Col. Sir WILLIAM HORROCKS. J. Royal Army Medical Corps, **45**: 167–189, 1925. Summary by the expert of British Army on quality of water.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Analyses of Rainfall from a Protected and an Exposed Gauge for Sulfur, Nitrates and Ammonia. E. M. JOHNSON. J. Am. Soc. Agron., **17**: 589, 1925. Work undertaken to evaluate influence of bird droppings on analysis of rain waters as collected from gauges. Bird droppings from an old loft showed 0.78 per cent S on dry basis of which 0.58 per cent was water-soluble. Actually found less S in water from exposed gauge than in that from protected gauge, due to biological action of bird droppings. More ammonia was found in the exposed gauge.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Sewage Pollution of Drinking Water for Cattle and Its Effect on Them. A. LEVIE. Veterinary Record, **5**: 692–693, 1925. Drinking sewage polluted water causes loss of appetite, unthriftiness, drowsiness, weariness, scouring, and sometimes vomiting. Septic swellings of throat occasionally occur. Cattle kept solely on water containing high proportion of crude sewage will die in about six months. Recovery on clean water requires about 3 to 6 months. Author thinks that toxins of sewage are important, and that cattle drinking sewage laden water are more susceptible to tuberculosis, Johnee's disease, and contagious abortion.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Use of Potassium Permanganate in Drinking Water for Poultry. SILVERT ERICKSEN. J. Am. Vet. Med. Assn., **67**: 496, 1925. Added to pink color. Recommended as very effective.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Effects of Drinking Water Polluted with Crude Oil. Anon. No. Am. Veterinarian, **6**: 13–14, 1925. Legal action in Illinois for loss of two cows was lost because of failure to prove that crude oil was cause of poisoning.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Observations on the Relation of Oil Pollution to Livestock Losses. A. H. GISH. North American Veterinarian, **6**: 51–52, 1925. Poisoning not uncommon from oil or salt from wells. Oil is injurious when consumed in large quantities, or when it comes into contact with large area of the body. In small quantity damage is doubtful unless long continued. Some animals become intoxicated, bloat, and may, or may not, belch up oil. Pupils dilate, respiration accelerates, and heart beats fast and weak. Muscular incoördination precedes death. Mild cases recover but never put on flesh well. Post mortem shows high state of inflammation of digestive tract, liver, kidneys, etc. Presence of considerable quantity of oil is conclusive evidence. Oil which has not lost its volatiles by exposure is likely to cause blistering and cracking of the skin. The salt water contains carbonates as well as NaCl.—*Jack J. Hinman. Jr.* (*Courtesy Chem. Abst.*)

Rapid Filters of the Stuttgart, Wurtemberg, Water Works. BAER. E. des Vereins deut. Ingenieure, June 6, 1925; Le Genie civil, **87**: 339, 1925. Water from the Neckar is submitted to prefiltration, put through sand filters and chlorinated.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Notes on the Control of Water Weeds. A. A. HANSEN. J. Am. Soc. Agron., **17**: 119–120, 1925. May be cut in ponds, lakes and ditches with a hand knife, sickle or scythe. For large amounts a submarine saw may be used. This is a thin ribbon-like flexible saw operated by two men, one on each bank. Chains and wire may also be used. A weed cutting launch is used by the Toronto park board. Fencing in and grazing sheep help to keep banks clean. Swans and ducks nip shoots and keep down growth. Sodium arsenite and other highly poisonous chemicals are not recommended. Copper sulfate in amount not over 1 pound per 125,000 gallons may be used. In Manitoba where wells are not practical holes are dug for the collection of rain water. $CuSO_4$ is used in these occasionally with good results.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Chemical Purification of the Boiler Feed Water of Locomotives on the Paris-Lyons-Marseilles System. VIGNAL. Rev. générale des Chemins de fer, May, 1925; Le Genie civil, **87**: 67–8, 1925. Lime soda process is used.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The "Filtrator" Apparatus for the Prevention of Scaling of Boilers. Anon. Le Genie civil, **84**: 410, 1924. Is not a filter, but an apparatus by means of which steam extracts mucilaginous material from flaxseed and returns with it to boiler. Emulsion formed is claimed to coat particles of precipitate and prevent formation of adherent scale.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Local Water Supply Fails: (Emergency Chlorinator Makes Temporary Supply Safe. Anon. Health News (N. Y.), **2**: 182, 1925. Leak in storage reservoir threatened water famine in Conisteo, Steuben County, N. Y., on Oct. 19th. Chlorination of water of some contaminated wells supplied need.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Carries Typhoid Quarter of Century. Anon. Health News (N. Y.), **2**: 184, 1925. Boarding house keeper was found responsible for 26 cases of typhoid fever. Of 12 cases since 1918, all but one have developed in other communities, mostly in New York City.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

On Structures which Develope in Certain Culture Media and Resemble Colonies of Microorganisms. P. P. LAIDLAW. Brit. J. Exptl. Pathology, **6**: 36–39, 1925. On serum agar colony-like masses which seemed to grow and allow transfer were found to be due to separation from the media of Ca and Mg soaps.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Correlation of Sulphite Reduction Test with Other Tests in the Bacterial Examination of Water. W. J. WILSON and E. M. BLAIR. J. Hyg., **24**: 111–119, 1925. Special medium is made of glucose agar (3 per cent agar) to each 100 cc. of which is added 1 cc. $FeCl_2$ 8 per cent solution; 0.6 cc. NaOH 10 per cent solution; 20 cc. Na_2SO_3 20 per cent solution. Forty cubic centimeters of water are mixed with 100 cc. medium and poured into large Petri dish. Layer of melted sulphite agar is then poured over hardened mixture to keep out air. Certain bacteria such as B. typhosus and B. enterditis Gaertner give deep black colonies. Most B. coli are unable to discolor media. B. welchii and some other forms give dark colored colonies. Bacteria responsible for vegetable decay are in general not sulphite reducers.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

A Note on the Effect of Dyes on Bacterial Growth. F. M. BURNET. Australian J. Biol. and Med. Sci., **11**: pt. 2, 77–82, 1925. There is close similarity between results of bacterial growth where fuchsin was added to agar plates and in plates exposed to light for H_2O_2 production tests. Fuchsin may interfere directly or indirectly with production or utilization of H_2O_2 by the organisms. Probably there is injury to mechanism for utilization of H_2O_2. Growth is sometimes possible with massive inoculation and impossible with a lighter one [cf. F. M. Burnet, *Australian J. Biol. and Med. Sci.*, **11**: pt. 2, 65–76 (1925)].—*Jack J. Hinman. Jr.* (*Courtesy Chem. Abst.*)

Bacillus Typhosus Morphologically Compared with Certain Bacilli Present in Natural Waters. LUCIUS NICHOLS, and EDWIN BURGESS. Ceylon J. Sci., Sect. D, Med Sci., **1**: pt. 2, 47-56, 1925. It was found that B. typhosus could be distinguished morphologically from B. coli and any of 40 bacilli isolated from water. Cultures for comparison were grown on nutrient agar containing 0.5 per cent added NaCl, on similar agar containing 1 per cent NaCl and on similar agar containing no added NaCl. The 40 bacilli isolated from water were capable of producing acid and gas from lactose broth in 33 cases, and capable of producing acid but not gas in 6 cases. A plea for more careful morphological study of the organisms is made.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Note on Determination of Temporary Hardness in Water. W. R. ATKIN and A. GARDNER. J. Soc. Leather Trades Chemists, **7**: 87–90, 1923. From Chem. Abst., **17**: 2023, June 10, 1923. Use of methyl orange for this deter-

mination requires clearly defined color for end point, and perceptible amount of acid is required to cause color change. Bromophenol blue changes color between pH 2.8 and 4.6 with sharp end point at 3.8. Alizarin, used in boiling solution, has range of color change near true neutrality and is extremely sensitive to acids. Preliminary titration is made and then second one in which most of acid required is added and solution boiled before alizarin paste is added. Stock solution of acetic acid and sodium acetate of pH value of 3.8 is made to facilitate obtaining correct shade. Good agreement is obtained with alizarin and bromophenol blue titrations, but end point is clearer and titration more convenient with latter indicator.—*R. E. Thompson.*

Hydrogen Sulfide Formation at the Bottom of the Lake of Onega. K. K. GILZEN. Bull. acad. sci. Russie, 1918, Series VI, 2232–40. From Chem. Abst., **17**: 2023, June 10, 1923. Formation of hydrogen sulfide at bottom of Lake of Onega was observed during dredging investigation. Samples of slimes collected at points where hydrogen sulfide was found were of creamy consistency, yellowish gray when dry, and contained about 6.5 per cent humus matter. Composition, dry basis, was: silica 52.6 per cent, alumina 8.94, ferric oxide 9.08, and sulfur 0.3. Organic matter contained large quantities of detritus and diatomacea. Formation of hydrogen sulfide was due to bacterial decomposition of inorganic sulfates and organic material containing sulfur. There was total exclusion of light, constant temperature of 4°, and pressure of 4–8 atmospheres.—*R. E. Thompson.*

Carbon Dioxide Springs in the Territory of Montepulciano. GAETANO CASTELLI. Rass. min. met. chim. **58**: 14–5, 1923. From Chem. Abst., **17**: 2023, June 10, 1923. Natural carbon dioxide spring at Montepulciano in Sant' Albino region described. The fissures are filled with slightly opalescent water, through which the gas issues, causing appearance of boiling, though water is only slightly above 0° and carbon dioxide 5-10°. Several hundred cubic meters of carbon dioxide per day are evolved with average composition of: carbon dioxide 95.40 per cent, oxygen 0.33, nitrogen 3.13, combustible gas 0.14, and hydrogen sulfide trace.—*R. E. Thompson.*

Water for Use in Retting Fibers. GOTTFRIED KRÄNZLIN. Faserforchung, **2**: 126–50, 1922. From Chem. Abst., **17**: 2054, June 10, 1923. Chemical analysis fails to yield information of great significance for evaluation of water supply for use in retting flax, etc. While it is generally agreed that iron and manganese in retting water cause discolorations which are hard to remove by modern methods of bleaching, it was not found possible to set maximum limit for concentration of these elements. Similarly hard water is generally condemned, but analysis of highly praised Lys river water show it to be rather hard. Complete analyses of 24 waters used in retting operations given. Iron, expressed as ferric oxide, varies from 0 to 3.1 p.p.m. and total hardness (German scale) from 1.5 to 24°.—*R. E. Thompson.*

The Testing of Durability and Rust-Preventive Properties of Paints. RUDELOFF. Mitt. Materialsprüfungsamt., **39**: 232–40, 1913. From Chem. Abst., **17**: 2057, June 10, 1923. Suggested methods outlined.—*R. E. Thompson.*

Basic Aluminum Sulfate. F. S. WILLIAMSON. J. Phys. Chem., **27**: 284-9, 1923. From Chem. Abst., **17**: 2089, June 20, 1923. When 2–4 molecules of sodium hydroxide are added to 1 molecule of potassium alum, composition of precipitate is invariable, analysis indicating basic sulfate of approximate composition: $Al_2(SO_4)_3 \cdot (Al_2O_3)_4 \cdot 15H_2O$. Compound $(Al_2O_6H_6)_2 \cdot H_2SO_4$ obtained by Schlumberger by addition of 5 molecules of potassium hydroxide to 1 of potassium alum (cf. Bull. soc. chim. 13, 41 — 1895) was mixture due to addition of excess potassium hydroxide. Above compound loses less than 10 per cent of its water over concentrated sulphuric aid at room temperature, but nearly all water is evolved at 150. Less than one-third is reabsorbed at lower temperatures, indicating that compound is not reversible hydrate.—*R. E. Thompson.*

A Method For the Determination of Dissolved Carbon Dioxide. F. G. HALL. J. Biol. Chem., **55**: 751–5, 1923. From Chem. Abst., **17**: 2123, June 20, 1923. Modification of apparatus of Van Slyke and of Van Slyke and Stadie (C. A. **11**: 2208; **16**: 728) adapted for use with large volumes, of liquid. Gases are liberated by repeated evacuations (10) and volume measured before and after absorption with potassium hydroxide.—*R. E. Thompson.*

The Volumetric Determination of Calcium. A. VÜRTHEIM and G. H. C. VAN BERS. Chem. Weekblad, 20, 68, 1923; J. GROSSFELD. Ibid, **20**: 209–10, 1923. From Chem. Abst., **17**: 2092, June 20, 1923. Objections are raised to method of G. (C. A. **17**: 1399) and further experiments described which appear to substantiate some of G.'s claims.—*R. E. Thompson.*

Determination and Correction of the Hardness of Water. ED. JUSTIN-MUELLER. Industrie chimique, **10**: 111–2, 1923. From Chem. Abst., **17**: 2158, June 20, 1923. Soap test for determining hardness, not differing essentially from standard method, described. Temporary hardness is eliminated by addition of proper amount of sodium hydroxide, which forms sodium carbonate, and latter reduces permanent hardness by amount equivalent to temporary hardness, so that sodium carbonate equivalent only to difference between permanent and temporary hardness need be added.—*R. E. Thompson.*

Industrial Water. G. PARIS. Chimie et industrie, **9**: 439–53, 1923. From Chem. Abst., **17**: 2159, June 20, 1923. General description of methods of purifying water, especially for boilers.—*R. E. Thompson.*

Rapid Determination of Total Iodine in Sulfur Waters. J. DUBIEF. Ann. fals., **16**: 80–2, 1923. From Chem. Abst., **17**: 2159, June 20, 1923. To 50 or 100 cc. of sample in 100 cc. glass-stoppered graduated cylinder add 4 cc. 10 per cent sodium bicarbonate and potassium permanganate (25 g. per liter) to pink coloration, and then 5 cc. in excess. Cool below 10°, add 2 cc. of carbon bisulfide and 5 cc. concentrated sulfuric acid dropwise, avoiding any rise in temperature, and decolorize with 3 per cent hydrogen peroxide (about 2 cc.). If sample contains more than 5 times as much bromine as iodine add drop of

0.1 N potassium thiocyante, shake, and repeat, alternating additions of potassium thiocyanate (avoiding excess) and shakings till yellow color of bromine is discharged. Shake till violet color of iodine in carbon bisulfide develops, and compare with standards prepared similarly. If there is less than 5 times as much bromine, addition of thiocyanate can be omitted. Chlorine does not interfere. By addition of thiocyanate, 0.05 mgm. of potassium iodide mixed with 0.1 g. of potassium bromide was determined. Method is sensitive to 0.02 mgm. per portion tested. Latter should not contain over 0.5 mgm. If temperature is kept below 10°, method is as accurate as sodium nitrite method.—*R. E. Thompson.*

Determination of Combined Carbonic Acid (Carbonate Ion) in Sulfur Waters. F. Touplain and J. Dubief. Ann. fals., **16**: 76–80, 1923. From Chem. Absts., **17**: 2159, June 20, 1923. To 200 cc. of water in 300 cc. Erlenmeyer flask add slight excess lead peroxide, shake 10–15 minutes, add 10 cc. 3 per cent hydrogen peroxide, heat gradually to 45°, maintain 30 minutes, allow to cool, filter, evaporate 100 cc. filtrate to dryness, take up with water, liberate carbon dioxide with sulphuric acid potassium bichromate mixture, and absorb in soda-lime.—*R. E. Thompson.*

Softening of Industrial Waters by Means of Permutite. D. Marotta. Giorn. chim. ind. applicata, **5**: 10–12, 1923. From Chem. Abst., **17**: 2159, June 20, 1923. Discussion of action of permutite upon hard waters, with analysis of sample of product and description of filters, their functioning and cost of maintenance.—*R. E. Thompson.*

Purification of Water with Lime. II. J. Smit. Meded. Burgerl. Geneesk. Dienst. Nederland. Indie, 1921, **2**: 111–89; Expt. Sta. Record, **47**: 288; cf. C. A., 15, 1050. From Chem. Abst., **17**: 2159, June 20, 1923. Action of quicklime, due to its high alkalinity, is much more marked than that of alum. The alkaline water is neutralized with small amount of carbon dioxide or by thorough aëration.—*R. E. Thompson.*

Fuel Consumption of the Different Types of Furnaces. W. Trinks. Fuels and Furnaces, **1**: 1, 41–2, 1923. From Chem. Abst., **17**: 2182, June 20, 1923. Table given showing British thermal units per gross ton heated and average thermal efficiency of 18 types of furnaces.—*R. E. Thompson.*

The Stein Recuperative Furnace. W. B. Chapman. Fuels and Furnaces, **1**: 1, 41–2, 1923. From Chem. Abst., **17**: 2182, June 20, 1923. Furnace described which is claimed to save fuel consumption by preheating air. Table given showing fuel saving by preheating air to temperatures from 200 to 1900° F., and for different excesses of air.—*R. E. Thompson.*

Water for the Dyehouse. Wm. C. Dodson. Textile Colorist, **45**: 156–7, 1923. From Chem. Abst., **17**: 2193, June 20, 1923. Decaying vegetable matter in reservoir gave rise to sufficient carbon dioxide in purified water to attack iron of piping and cause trouble with spots on fabrics.—*R. E. Thompson.*

Residual Waters of Cokeries. R. DURAND. Bull. soc. pharmacol., **30**: 216–9, 1923. From Chem. Abst., **17**: 2186, June 20, 1923. Dead fish on surface of Marne indicated presence of poison, probably from coke ovens. Analysis proved water from condenseries in cokeries, before purification, contained 0.085–0.17 gram hydrogen sulfide and 0.07–0.12 gram hydrocyanic acid per liter. Water from drain, after purification, contained 0.005–0.007 gram hydrogen sulfide and 0.0021–0.04 gram hydrocyanic acid per liter. Water of river 15 meters below entrance of drain from purification plant contained no measurable amount of either impurity. If water is properly purified with chlorine no trace of these compounds remains.—*R. E. Thompson.*

Behavior of Ozone. E. H. RIESENFELD. Z. Elektrochem., **29**: 119–21, 1923. From Chem. Abst., **17**: 2210, July 10, 1923. Physical data on ozone given.—*R. E. Thompson.*

The Reaction Between Hypochlorite and Potassium Iodide. I. M. KOLTHOFF. Rev. trav. chim., **41**: 615–26, 1922. From Chem. Abst., **17**: 2245, July 10, 1923. Interesting data on reaction which may be employed for evaluating calcium hypochlorite and other hypochlorites.—*R. E. Thompson.*

Testing of Bleach Liquor. R. E. GEGENHEIMER. Textile Colorist, **45**: 167–8; Color Trade J., **12**: 131–2, 1923; Paper Mill, **47**: 9, 14, 16 (1923). From Chem. Abst., **17**: 2248, July 10, 1923. Description of simple apparatus for approximate determination of available chlorine in bleaching solutions by hydrogen peroxide gas-buret method, in which pressure generated by oxygen evolved gives direct reading in grams available chlorine per liter.—*R. E. Thompson.*

Corrosion Tests on Metals and Alloys in Acid Water from Coal Mines. W. A. SELVIG and GEO. M. ENOS. Carnegie Inst. Tech. Coöperative Mining Courses Bull., **4**: 1922. From Chem. Abst., **17**: 2259, July 10, 1923. Results of tests of corrosion of various metals and alloys by three acid mine waters.—*R. E. Thompson.*

Electric Welding of Cast Iron. LEBRUN. Rev. métal, **20**: 248–9, 1923. From Chem. Abst., **17**: 2259, July 10, 1923. To obtain satisfactory electric weld of gray cast iron, means must be provided for continuous addition of carbon to replace that burnt by arc, otherwise weld would be transformed into white cast iron.—*R. E. Thompson.*

Seasonal Variations in the Dissolved Oxygen Content of the Water of the Thames Estuary. WM. BUTLER and J. H. COSTE. Biochem. J., **17**: 49–58, 1923. From Chem. Abst., **17**: 2291, July 10, 1923. Water is appreciably supersaturated with oxygen even though in free contact with air. Marked alkalinity and supersaturation occur together. Still weather tends to preserve supersaturation. When water is agitated by wind supersaturation disappears rapidly. Oxygen of supersaturation is but a proportion, and probably small one, of volume set free by marine photosynthesis. It has always been realized

that sea acts as great stabilizer of carbon dioxide content of air by reason of bicarbonate-carbonate equilibrium. It appears equally efficacious in maintaining, by continual contributions, constant proportion of oxygen in air.—*R. E. Thompson.*

Pollution of Drinking Water by Intestinal Bacteria. ERIK BONDO. Nord. hyg. Tids., 2, **13**: 1921; Absts. Bact., **5**: 512. From Chem. Abst., **17**: 2336, July 10, 1923. No difference was found in acid production by B. coli from warm-blooded or cold blooded animals, but indol production was negative with latter and positive with majority of former.—*R. E. Thompson.*

Methods of Drinking-Water Examination. W. OLSZEWSKI. Chem.-Ztg., **47**: 273, 1923. From Chem. Abst., **17**: 2336, July 10, 1923. Volumetric estimation of sulfate by benzidine method is advised. Manganese may be detected by following method, using same sample for determination of ammonia. Treat 300 cc. of sample with sodium bicarbonate and allow to stand several hours. Decant 200 cc. for ammonia determination, thoroughly shake remainder and filter. Treat residue with benzidine acetate solution and dilute to 300 cc. Blue color shows presence of manganese. Iron salts do not interfere. Benzidine acetate solution is prepared as follows: grind 20 grams benzidine with 20 cc. water, transfer to liter measuring flask and add about 750 cc. water and 50 cc. acetic acid and dilute to mark. Shake, allow to stand one day and filter. Solution should be kept in dark flask. Test is sensitive to 1 part in 125,000,000. Qualitative tests for manganese were also made with *o*-tolidin, but iron oxidation products also produced blue color. For estimation of manganese, Marschall test (Hyg. Wassers, 1915) is recommended.—*R. E. Thompson.*

Hydrogen-Ion Concentration of Natural Waters in Relation to Disease. W. R. G. ATKINS. J. State Med., **31**: 223–6, 1923. From Chem. Abst., **17**: 2336, July 10, 1923. Natural waters vary from pH 5 for bog pool to about pH 8.3 for stream saturated with calcium bicarbonate. Reaction of natural waters, normally between pH 6.8 and 8.0, is favorable for existence of Vibrio cholerae and bacilli of typhoid group. In contrast to acid limits of Dernby and others, suggestion is made that water may be rendered safe for drinking by increasing pH to 10.5 by addition of ash derived from vegetable matter, which is rich in sodium and potassium carbonates. Necessity of stating temperature when limiting and optimal values are given for growth of various organisms is noted.—*R. E. Thompson.*

Heteromorphism of Calcium Carbonate. Marble, Synthetic and Metamorphic. MAURICE COPISAROW. J. Chem. Soc., **123**: 785–96, 1923. From Chem. Abst., **17**: 2376, July 20, 1923. Investigation of colloidal and gelatinous state of calcium carbonate observed by NEUBERG and REWALD (cf. C. A. 3, 155) and transformation of various forms of calcium carbonate indicate: (a) Formation of hydrocalcite, calcite, aragonite and precipitated chalk by double decomposition of alkali carbonates and soluble calcium salts is effected in stages—diffusion, solution, gelatinous form, and solid: final form

of solid depending on experimental conditions. (b) Gelatinous phase obviated by slow diffusion may, under favorable conditions, be prolonged practically indefinitely. This form, which exists in aqueous medium, has shorter range of existence and can be less definitely characterized than colloidal calcium carbonate prepared by ROSE (cf. Pogg. Ann. **42**: 354). It may be regarded as unoriented molecular aggregates of hydrocalcite formed in course of forced transformaton of initial liquid magma into hydrocalcite. **Heteromorphism of Calcium Sulfate. Alabaster and Its Synthesis.** Ibid. 796–9. Neither state of temporary supersaturation nor gelatinization occurs in formation of calcium sulfate, probably because it shows no tendency to form varieties of hydrates of greater hydration than gypsum.—*R. E. Thompson.*

The Aëration of Quiescent Columns of Distilled Water and of Solutions of Sodium Chloride. W. E. ADENEY, A. G. G. LEONARD and A. RICHARDSON. Phil. Mag., (6) **45**: 835–45, 1923. From Chem. Abst., **17**: 2377, July 20, 1923. Aëration of quiescent bodies of fresh or salt water under natural conditions is effected by process of mixing of exposed layer to depths of 10 feet at least. Mixing is caused by downward "streaming" of constantly changing exposed layer probably to depths much greater than 10 feet. Streaming takes place more uniformly in salt than in fresh water; is largely dependent on cooling by evaporation from surface, and is more rapid at 10° or above. Optimum concentration of salt appears to be about 1 per cent.—*R. E. Thompson.*

The Ageing of Thiosulfate Solutions. E. ABEL. Ber., **56B**: 1076–9, 1923. From Chem. Abst., **17**: 2404, July 20, 1923. Great number of contradictions regarding stability of standard sodium thiosulfate solutions occur in literature. Use of distilled water containing trace of copper, which catalyzes oxidation of thiosulfate to tetrathionate by atmospheric oxygen, suggested as one possible cause of deterioration, and use of water distilled from glass advised.—*R. E. Thompson.*

Corrosion of Rust-Proofed Iron and Steel. W. P. WOOD. Chem. Met. Eng., **28**: 769–72, 1923. From Chem. Abst., **17**: 2409, July 20, 1923. Iron and steel, uncoated and after having undergone various rust-proofing processes, were tested for corrosion in slowly moving water saturated with oxygen. Presence of oxygen apparently causes exaggerated initial corrosion in iron and low-carbon steel. Small amount of chlorine in tap water causes slight increase in corrosion rates of immersed metals. Copper content of iron and steel does not affect rate of corrosion. Different surface conditions of metal tend to become equalized over period of time and corrosion rates to become steady and uniform when large amounts of oxygen are present. Oxygen does not appear to increase pitting. Galvanizing seems to be best means of preventing corrosion.—*R. E. Thompson.*

The Titration of Culture Media. L. MICHAELIS. Z. Immunitäts, **32**: 194–203, 1921. From Chem. Abst., **17**: 2433, July 20, 1923. H-ion concentration of media determined with 0.3 per cent m-nitrophenol, using wooden block comparator in which compensation is made for color of broth by placing

tube of same behind color standards. Autoclaving ordinary broth does not change pH. Diluting with salt solution also has no effect on pH, owing to buffering effect of peptone and phosphates.—*R. E. Thompson.*

Comparative Investigation of Mineral and Plant Oils Used for Lubricating Purposes. M. A. RAKUSIN. Petroleum Z., 19: 454–6, 1923. From Chem. Abst., 17: 2464, July 20, 1923. Viscosity at different temperatures and other physical data on various lubricating oils given.—*R. E. Thompson.*

Development of the Uses of Liquid Chlorine in Germany. HENRI MURAOUR. Chimie et industrie, 9: 806–8, 1923. From Chem. Abst., 17: 2464, July 20, 1923.—*R. E. Thompson.*

Barium in the Harrogate Waters. A. WOODMANSEY. Lancet, 1923, 1: 22; Pharm. J., 110: 30, 1923. From Chem. Abst., 17: 2465, July 20, 1923. Presence of 3.51–6.91 parts per 100,000 of barium and 1:140,000 and 1:190,000 of dissolved barium sulfate in Harrogate spring waters is noted. In very low concentrations barium exerts marked stimulating action on all forms of muscular tissue and causes gradual but sustained rise in blood pressure.—*R. E. Thompson.*

The Sulfur Content of Rain Water. L. N. ERDMAN. Soil Science, 14: 363–7, 1922. From Chem. Abst., 17: 2465, July 20, 1923. Sulfur content of rain water in Iowa under rural conditions was 3.32 p.p.m.—*R. E. Thompson.*

Effects of Water Treatment on the Reduction of Maintenance Expense and Increasing Capacity of Locomotives. W. C. SMITH. J. Western Soc. Engineers, 28: 220–3, 1923. From Chem. Abst., 17: 2465, July 20, 1923. Mo. Pacific R. R. operates 81 softening plants, 36 of which are of intermittent type and 45 of continuous type. Six additional plants are under construction. Large savings are realized.—*R. E. Thompson.*

The Effect of Gambusia Affinis on the B. Coli Index of Pollution of Water. L. C. HAVENS and SOPHIE A. DEHLER. Am. J. Hyg., 3: 296–9, 1923. From Chem. Abst., 17: 2465, July 20, 1923. Normal intestinal flora of Gambusia (top minnows) in Alabama waters is represented by B. pyocyaneus and an unindentified, aërobic, lactose-fermenting, spore-forming bacillus. B. coli was not found in intestinal tract. When Gambusia was added to polluted waters B. coli disappeared, due largely to inhibitory influence of B. pyocyaneus hence B. coli index may be rendered unreliable guide to pollution by these minnows.—*R. E. Thompson.*

Some Factors Affecting the Evaporation of Water from Soil. E. A. FISHER. J. Agr. Sci., 13: 122–43, 1923. From Chem. Abst., 17: 2466, July 20, 1923. Subject is developed from physico-chemical and mathematical standpoint, with detailed experimental data.—*R. E. Thompson.*

The Manufacture of Bleaching Powder. OTTO NYDEGGER. Industrie chimique, 10: 151–3, 1923; World's Paper Trade Rev., 79: 1822, 1824, 1923. From Chem. Abst., 17: 2477, July 20, 1923.—*R. E. Thompson.*

Effect of Carbon Dioxide Variation on Boiler Efficiency. W. P. CREWS. Elec. World, **81**: 1218, 1923. From Chem. Abst., **17**: 2493, July 20, 1923. Relationship between superheat and carbon dioxide and efficiency at various boiler ratings is shown. It is advisable to maintain maximum carbon dioxide, keep superheaters clean and let superheat come where it will. Gain in efficiency due to high superheat is not as reliable as that obtained with good combustion in boiler and high carbon dioxide content.—*R. E. Thompson.*

Corrosion and Other Deposits in Gas Services. B. RICHARDSON. Gas. J., **162**: 348–50, 1923. From Chem. Abst., **17**: 2493, July 20, 1923. Corrosion is primarily due to combined action of water, carbon dioxide and oxygen on ironwork of mains.—*R. E. Thompson.*

The Titration of Hypochlorous Acid. A. SCHLEICHER. Z. anal. Chem., **62**: 329–35, 1923. From Chem. Abst., **17**: 2543, August 10, 1923. Clarens (C. A. **8**: 3279) claimed that chlorine peroxide vapors are formed in titration of sodium hypochlorite or bleach solutions with arsenious acid. Experiments with ordinary titration with iodo-starch paper as indicator have failed to confirm C.'s assertion and addition of potasium bromide as indicator, as recommended by him, was found unsatisfactory. Mechanical stirring was found better than hand stirring. Good agreement was obtained by electrometric titration against buffer solution.—*R. E. Thompson.*

Estimation of Magnesium in Sea Water by the Use of a Single Drop of Sea Water. G. DENIGÈS. Compt. rend., **175**: 1206–8, 1923. From Chem. Abst., **17**: 2543, August 10, 1923. Series of standards is prepared by adding 0-14 drops of 0.0005 N. magnesium sulfate solution to different tubes, each of which is diluted to 5 cc., and treated with 1 drop of 3 per cent sodium chloride, 0.5 cc. 10 per cent potassium iodide and 2 drops freshly prepared sodium bromate. Color obtained with sea water similarly diluted and treated with potassium iodide and sodium bromate is matched with these standards.—*R. E. Thompson.*

The Bursting of Steam Boiler Tubes During Use. WALTER RITTER. Feuerungstechnik, **11**: 39, 1922. From Chem. Abst., **17**: 2550, August 10, 1923. Martensitic structure at point of rupture showed that tube had been heated at some time to above 700 and suddenly cooled. Contributory causes were corrosion by sulfur dioxide and uneven wall thickness.—*R. E. Thompson.*

The Disinfecting Action of Lime Water. JAN SMIT. Chem. Weekblad, **20**: 263, 1923. From Chem. Abst., **17**: 2591, August 10, 1923. Addition of 74 p.p.m. of lime kills cholera vibrio within 30 minutes.—*R. E. Thompson.*

The Effects of Certain Concentrations of Hydrogen Ions upon Intestinal Bacteria. K. SCHEER. Z. Immunitäts., I Abt., Orig., **33**: 36–42, 1921; Absts. Bact., **6**: 106; cf. C. A., **16**: 3921. From Chem. Abst., **17**: 2592, August 10, 1923. Data on final pH produced by intestinal bacteria in bouillon containing sugar and on H-ion concentrations which are fatal to these bacteria. After

3 days growth in broth containing 5 per cent lactose, with original reaction of pH 6.7, B. coli produced final reaction of pH 5. Resistance to bactericidal action of acid varies with time of exposure. In 24 hours B. coli was killed in fluid at pH 4.7, and B. typhosus at pH 5. These figures are said to be fairly characteristic of species of organism, being definite value in each case.—*R. E. Thompson.*

The Bacteriophagy and the Self-Purification of Water. P. C. FLU. **Proc.** Acad. Sci. Amsterdam, **26**: 116–21; Tijdsher. vergelijk. Geneeskunde, **8**: 218–33, 1923. From Chem. Abst., **17**: 2623, August 10, 1923. Bacteriophagy plays no part in self-purification of water.—*R. E. Thompson.*

Purification of Waste Waters By Means of Clay. Carré. Halle aux Cuirs, **2**: 40, 1923. From Chem. Abst., **17**: 2624, August 10, .1923. System of treatment outlined. Cf. C. A. **16**: 3989.—*R. E. Thompson*

Chlorine, Chlorine Hydrate, and Waste Waters. RAYMOND FOURNIER. Papeterie, **45**: 374–8, 418–25, 1923. From Chem. Abst., **17**: 2643, August 10, 1923. Waste liquors are discussed from standpoint of stream pollution.—*R. E. Thompson.*

Control of Water Consumption in the Chemical Industries. Anon. Chem.-Ztg., **47**: 481–4. 1923. From Chem. Abst., **17**: 2758, August 20, 1923. Several water meters described.—*R. E. Thompson.*

Mechanism of So-Called Dry Corrosion of Metals. U. R. EVANS. Trans. Faraday Soc. (advance proof), 1923. From Chem. Abst., **17**: 2699, August 20, 1923. Researches are described showing effect on "apparently dry" corrosion of presence of volatile liquids, of contact with dissimilar metal, and of humidity. Phenomena are best explained if it is considered that electrochemical action occurs in adherent (usually invisible) film of moisture. Volatile electrolytes increase conductivity of film and thus accelerate corrosion. Where there is tendency to produce hygroscopic corrosion products, more moisture is absorbed and film thickness increased; in some cases metal soon sheds liquid copiously and serious corrosion results.—*R. E. Thompson.*

The Use of Sodium Chloride as a Standard in the Determination of Halogens in Sea Water. J. GIRAL and F. A. GILA. Compt. rend., **176**: 1729–30, 1923. From Chem. Abst., **17**: 2687, August 20, 1923. Series of gravimetric analyses shows that presence of sodium, magnesium and calcium sulfate in sea water does not sensibly affect determination of halogens as halide.—*R. E. Thompson.*

Acid-Resisting Alloys for Use in Mine Water. GEO. M. ENOS. Coal Age, **23**: 685–8, 1923. From Chem. Abst., **17**: 2700, August 20, 1923. Results of tests of resistance to corrosion of many different alloys in slowly moving mine water given.—*R. E. Thompson.*

A Method for the Detention of Phenols Produced by Bacteria. WILLIAM H. BELL. J. Inf. Dis., 29: 424–8, 1921. From Chem. Abst., 17: 2720, August 20, 1923. Acidified fluid medium is subjected to steam distillation, and presence of phenols in distillate is indicated by production of red color when diazotized p-nitroaniline in alkaline solution is added. Method will show on blank determinations distinct yellowish red color with phenol diluted 1:1,000,000. Phenol in concentrations of 1:500,000 can easily be detected in culture mediums.—*R. E. Thompson.*

Occurrence of Iodine in Nature. TH. VON FELLENBERG. Mitt. Lebensm. Hyg., 14: 161–240, 1923. From Chem. Abst., 17: 2717, August 20, 1923. Historical sketch given of studies upon iodine from work of Chatin (cf. Compt. rend. 30–39, 46, 50, 82 (1850–1876) to isolation of thyroxin by Kendall (cf. C. A. 14: 407). Relationship between amount of iodine in drinking water and prevalence of goiter and cretinism is discussed. Special analytical methods given for determination of iodine in water.—*R. E. Thompson.*

Calculation of Charts for Flue Gas Analysis. PAUL SCHRIEBER. Arch. Wärme-wirtschaft, 3: 231–3, 1922. From Chem. Abst., 17: 2774, August 20, 1923. Description of theory and construction of various simple charts for determining excess air and completeness of combustion from flue gas analyses.—*R. E. Thompson.*

The Relations Between the Radioactivity, the Temperature and the Sulfuration of the Springs of Bagnerès-de-Luchon. Explanatory Hypothesis. ADOLPHE LEPAPE. Compt. rend., 176: 1908–10, 1923. From Chem. Abst., 17: 2819, September 10, 1923. Springs emerging from schists are more radioactive than those from granite. In general, radioactivity varies inversely with temperature and sulfuration, but in few cases it varies directly with sulfuration. There are two types of water: deep water, hot, with high sulfuration and little radioactivity and surface water, cold, not sulfurated, but radioactive. Nature of spring waters is determined by how much these two types are able to mix.—*R. E. Thompson.*

The Importance of Chlorine in Water Purification. H. SELTER and W. E. HILGER. Gesundh. Ing., 46: 126–8, 1923; Gas u. Wasserfach, 66: 292. From Chem. Abst., 17: 2927, September 10, 1923. Chlorination results in complete destruction of bacteria, disproving idea that bacteria in chlorinated water regain power of causing infection.—*R. E. Thompson.*

The Radioactivity of the Springs of Some Stations of the Pyrenees (Bagnères-de-Luchon, Vermet, the Escaldes, Thuès) and of the Central Plateau (the Bourboule, Royat, Saint-Nectaire, Sail-les-Bains). ADOLPHE LEPAPE. Compt. rend., 176: 1702–5, 1923. From Chem. Abst., 17: 2820, September 10, 1923. Table given showing Ra Em per liter in more active mineral waters of France.—*R. E. Thompson.*

The Clarifying Plant for the Purification of Waste Water by Gas at the New Foundry of the Mansfeld Copper Shale Works. F. H. SCHILLING. Wasser,

18: 51-2; Chem. Zentr., 1922, IV: 360. From Chem. Abst., 17: 2847, September 10, 1923. Purification of waste water by gas, separation of suspended matter, which consists chiefly of metallic dust and oily and tarry constituents, is facilitated by decreasing velocity.—*R. E. Thompson.*

Microstructural Aspects of Metals and Alloys Corroded by Acid Mine Water. R. J. ANDERSON and GEO. M. ENOS. Carnegie Inst. of Tech. Coöperative Mining Courses, Bull. 5; From Chem. Abst., 17: 2852, September 10, 1923. Results given of microscopic examination of corroded test specimens of metals and alloys which had been immersed in acid mine waters and previously reported on in Bulletin 4.—*R. E. Thompson.*

Corrosion of Copper by Salt Solutions. W. MÜLLER. Z. Metallunde, 14: 286-95, 1922. From Chem. Abst., 17: 2852, September 10, 1923. Copper is rapidly corroded by sea water and by sodium and magnesium chlorides, with formation of green basic chloride which readily detaches itself from the metal and therefore does not form protective coating. Weak solutions of magnesium and calcium sulfate corrode copper very slowly, metal becoming gradually covered with white precipitate containing bluish green flakes of basic sulfate.—*R. E. Thompson.*

Alloys Resistant to Mineral Acids and Their Application to the Construction of Apparatus. B. WAESER. Apparatebau, 34: 129-33; Chem. Zentr., 1922, IV, 222. From Chem. Abst., 17: 2857. Physical properties, method of working, and applications of Krupp V2A Steel (chromium-nickel steel) and silicon alloys of iron discussed.—*R. E. Thompson.*

The Bearing Metal "Thermit." G. v. HANFFSTENGEL. Z. Ver. Deut. Ing., 67: 455, 1923. From Chem. Abst., 17: 2858, September 10, 1923. New bearing metal put out by Th. Goldschmidt A. G., containing nickel, lead, tin and other metals, is claimed to be equal, or superior, to white metal and to melt at least 120° lower, i.e., 480° compared with 600°.—*R. E. Thompson.*

Effect of Mineral Salts on the Growth of Bacteria. C.-E. A. WINSLOW and MARGARET HOTCHKISS. Sci. Proc. Soc. Am. Bact., Dec., 1921; Absts. Bact., 6: 4, 1922. From Chem. Abst., 17: 2899, September 10, 1925. Ammonium chloride has no stimulating action on bacterial growth, and exerts inhibitive action in molar concentration. Other salts studied stimulate growth in high dilution and inhibit in low dilution. Molar concentrations at which these respective actions are apparent on B. coli are: calcium chloride 0.01 and 0.5, magnesium chloride 0.05 and 0.5, strontium chloride 0.1 and 1.0, sodium chloride 0.5 and 3.0, potassium chloride 0.5 and 4.0.—*R. E. Thompson.*

Information Concerning Some Microbiological Works in Progress. GIACOMO ROSSI, E. CALENDOLI C. COLIZZA and E. PALMIERI-NUTI. Ann. scuola agr. Portici., (2), 15: 1-12, 1920. From Chem. Abst., 17: 2901, September 10, 1923. **IV. New Studies on Bacillus coli.** Inoculation of peptonized water and Eijkmann's liquid indicate that B. coli is far from being as abundant in soils (even manured) as commonly stated.—*R. E. Thompson.*

Report on Universal Metering for the City of Chicago. MAURY and GORDON. Engr. and Contr., **64**: 343–53, 1925. Detailed report shows that installation of meters can stop annual deficits and save huge costs of additional plant.—*C. C. Ruchhoft.*

The Setting of Water Meters. JOHN L. FORD. Engr. and Contr., **64**: 361–3, 1925. Conditions to be met, type of setting, and means of assuring efficient service are described.—*C. C. Ruchhoft.*

A Southern Well and Its Screen. J. R. AGNEW. Engr. and Contr., **64**: 368–9, 1925. Description, with diagrams, of Clarksdale, Miss., well and pump is given. Screens are placed at three strata in one bore and produce fine yield.—*C. C. Ruchhoft.*

Sewage Disposal Problems in Kansas. ERNEST BOYCE. Munic. and County Engr., **69**: 41–44, 1925. General discussion of sewage disposal problems of Kansas.—*C. C. Ruchhoft.* (*Courtesy Chem. Abst.*)

The Glass Covered Sludge Drying Bed. WALDO S. COULTER. Munic. and County Engr., **69**: 57–60 (1925). The hotbed and greenhouse types of covered sludge drying beds are described. Partition walls so that fresh sludge may be separated from partly dried sludge, proper ventilation and protection of the glass with wire screen for small plants are discussed.—*C. C. Ruchhoft.* (*Courtesy Chem. Abst.*)

Fridley Conduit, St. Paul Water Works. J. W. KELSEY. Munic. and County Engr., **69**: 70–73, 1925. Construction features of 60-inch inside diameter conduit are given. Water is pumped from Mississippi River through this conduit to Charles Lake, a distance of 8 miles. Steel pipe having a semi-rubber base coating was used for first 8150 feet. Balance of conduit was constructed of reinforced concrete poured directly in place, with construction joints every 20 feet.—*C. C. Ruchhoft.* (*Courtesy Chem. Abst.*)

Notes on Toledo's Water Supply Problem. W. J. SHERMAN. Munic. and County Engr., **69**: 133–5, 1925. Data are presented showing the advisability of the Miami and Erie Canal as source of Toledo's water supply.—*C. C. Ruchhoft.* (*Courtesy Chem. Abst.*)

The Trend of Purification Plant Design and Operation. WELLINGTON DONALDSON. Engr. and Contr., **64**: 371–76, 1924. There has been an improvement in appearance of buildings and grounds and also in interior treatment. Tendency has been toward greater flexibility of operation and adequate metering of water flows, master venturi meters being usually provided either at input or output. Aëration, by various styles of aërators, for removal of odors and of iron, is being used by an increasing number of plants. Preliminary sedimentation before application of coagulant has proven advantageous for plants handling very muddy waters. There is no remarkable improvement in coagulation basin design but there have been improvements in clean-

ing arrangements. Dry feeding devices are gaining popularity. Perforated pipe is leading in popularity for rapid sand filter underdrains. Use of air wash in addition to water wash is almost obsolete. There is great diversity in design of auxiliary filter equipment. Practically all sterilization is now done with liquid chlorine. Value of good records and reports is being realized, and better trained operators are in demand.—*C. C. Ruchhoft.* (*Courtesy Chem. Absts.*)

Survey Shows How Niagara Falls is Receding. Eng. News-Rec., **95**: 636–7, October 15, 1925. Illustrated data given showing rate of recession of Niagara Falls as evidenced by surveys of 1764, 1842, 1875, 1917 and 1925. Study of figures indicate that since 1906 amount of rock excavated annually has been somewhat less than formerly was case, but that maximum lineal recession at apex of Horsehoe is greater than formerly, probably due to diversion of 15 per cent of mean flow by power companies and concentration of flow into limited crest line respectively. Annual recession over period 1764–1925 has averaged 4,820 square feet, and mean rate of recession 4 feet per year.—*R. E. Thompson.*

Mast and Spout Concreting Plant Has Special Features. Eng. News-Rec., **95**: 684–5, October 22, 1925. Illustrated description of concreting plant employed in construction of memorial hospital and medical hall at University of Chicago. Entire area, 299 by 363 feet, and 266 by 45 feet, was served by 3 steel masts with long spouting systems. Two hundred cubic yards of concrete was poured from each tower in 8-hour day. Average of 420 cubic yards was placed daily by means of 3 towers and 21 men.—*R. E. Thompson.*

Two Water Mains in Wide Streets. CALEB MILLS SAVILLE. Eng. News-Rec., **95**: 646–7, October 15, 1925. Advantage of 2 mains on wide streets has become so obvious that in future it is planned to follow this procedure on all wide streets in Hartford, Conn. Examples given of existing applications of this practice. Service pipes are not laid in advance of pavement in Hartford, this being considered impracticable. All services now installed up to and including 2-inch are cement-lined wrought iron; or brass, if applicant pays difference in cost. One-inch cement-lined pipe costs about 25 cents per foot. Charges for making connections and maintenance thereafter, in improved pavement and other locations respectively, are: 1-inch, $75, and $45; 1½-inch, $90 and $60; 2-inch, $105 and $75; 4-inch, $280 and $250; 6-inch, $360 and $330. City claims title to these connections and they are carried as part of plant value, being charged to capital account.—*R. E. Thompson.*

Survey Control in Driving 3-Mile Water Supply Tunnel. RICHARD R. BRADBURY. Eng. News-Rec., **95**: 594–8, October 8, 1925. Detailed description of survey methods employed on 3½-mile hard rock tunnel which constitutes part of new 12-mile aqueduct from Pawtuxet River, source of new water supply of Providence, R. I., to present distribution system. Earth dam is under construction on river which will impound 37,000 m.g.—*R. E. Thompson.*

Depreciation on Slip-Jointed Steel Pipe. E. COURT EATON. Eng. News-Rec., 95: 603–4, October 8, 1925. Brief details given of two irrigation systems—Lindsay Strathmore and Terra Bella—in San Joaquin Valley. Pipe used was slip-joint light riveted steel, 4 to 36 inches in diameter, protected by dipping and covering with high grade roofing paper lapped spirally under tension. Location is one where dipped unprotected pipe has very short life. Cost of 180 miles of pipe in two systems averaged $5,450 per mile, and maintenance and repair cost for 6 years 1919–1924 averaged $11.60 per mile. Number of leaks occurred with approach of cold weather due to contraction of slip joints and others developed where protective covering had been damaged during installation.—*R. E. Thompson.*

Mokelumne Water Supply Contracts Let. Eng. News-Rec., 95: 608, October 8, 1925. Contract awards announced totalling $11,751,427, included in which is 85 miles of electrically welded steel pipe to be manufactured in Oakland, Cal. Diameter of pipe will be 60–65 inches, and heads will range up to 380 feet. Samples submitted have shown beyond question possibility of securing welded joints which are 100 per cent efficient. Adoption of this method of manufacture will save East Bay Municipal Utility District $4,000,000.—*R. E. Thompson.*

Power Head Totally Enclosed in Deep Well Pump. Eng. News-Rec., 95: 652, October 15, 1925. Brief illustrated description of pump with power head completely enclosed, manufactured by American Well Works, Aurora, Ill. Recommended for heads up to 600 feet and discharge up to 250 g.p.m.—*R. E. Thompson.*

Further Data on Moccasin Creek Penstock Breaks. Eng. News-Rec., 95: 666–7, October 22, 1925. Discussion of damage sustained by Moccasin Creek power plant on San Francisco's municipally owned and operated Hetch Hetchy project as result of violent water hammer due to failure to open bypass valve which would fill section of pipe between nozzle and main gate valve, before opening main gate valve itself.—*R. E. Thompson.*

Diesel Engine Exhaust Manifold Made of Corrugated Steel. Eng. News-Rec., 95: 695, October 22, 1925. Brief description of large manifold for controlling noise from installation of 6 Diesel engines—2 each of 500, 750, and 1000 h.p.—recently constructed at El Paso, Tex. Manifold is 36 inches in diameter, 104 feet long, and has 50-foot stack. Noise of engines could formerly be heard within 3-mile radius.—*R. E. Thompson.*

St. Cloud, Minn. Eng. News-Rec., 95: 672, October 22, 1925. Mississippi River water is chlorinated and purveyed, but no one drinks it, water from private or community wells being preferred. Sixty per cent of population of 21,300 indicated in referendum that they were satisfied with such procedure, and of other 40 per cent, 60 per cent favor filtration and remainder, softened well water system. Forty pounds pressure is maintained, boosted to 80–100 during fires, and although consumer obtains no culinary supply, all but 200

taps of the 2500 services are metered, charge for water being 20 cents per 1000 gallons. Consumption varies between 1.3 and 5 m.g.d.—*R. E. Thompson.*

Cutting Piling Under Water—Review of Various Methods. SAMUEL P. BAIRD. Eng. News-Rec., 95: 601–2, October 8, 1925. Brief outline and discussion.—*R. E. Thompson.*

New Jersey Engineers Study Shore Erosion and Protection. Eng. News-Rec., 95: 598–600, October 8, 1925. Conclusions and recommendations of Bd. of Commerce and Navigation of N. J., re coast protection, reproduced from recently issued report.—*R. E. Thompson.*

Bacterial Life Below Earth Surface. EDSON S. BASTIN, FRANK E. GREER and GAIL MOULTON. Science, 62: X, November 6, 1925. Of 25 samples of oils and associated waters derived from continuously flowing wells, depths of which were 500–1500 feet, 23 contained an abundance of bacteria of types similar to those present in ocean water.—*R. E. Thompson.*

1400-Foot Submarine Water Main Pulled into Place across Vancouver Harbor. Cont. Rec., 39: 810, August 19, 1925. Brief description of 1400-foot section of 18-inch pipe which was recently successfully pulled into place across bed of First Narrows at entrance to Vancouver Harbor. Section, together with cables and tackle, weighed 330 tons, and entire operation of placing was completed in 12 hours. Actual time pipe was in motion was 69 minutes.—*R. E. Thompson.*

Pocatello, Idaho. Eng. News-Rec., 95: 627, October 15, 1924. Water supply system, municipally owned since 1916, described briefly. Three sources of supply utilized, most distant being Mink Creek from which water is conveyed to city through 10-mile 14-inch wood-stave pipeline. Plans in preparation for storage reservoir of 100-m.g. capacity, which will provide required sedimentation. As watershed is subject to contamination, chlorination is employed. Daily per capita consumption varies from 90 gallons in winter to 167 in summer. Approximately 90 per cent of services metered. Secondary low pressure supply from Fort Hall irrigation project is provided in alleys to serve irrigation purposes only. Property owners charged flat rate of 10 cents per front foot per season for one tap per building lot.—*R. E. Thompson.*

Wave-Actuated Water Hammer Splits 36-Inch Sewer Outlet at Paducah, Ky. A. T. MALTBY. Eng. News-Rec., 95: 629, October 15, 1924. Breaks in 350 feet of 36-inch vitrified pipe sewer outlet attributed to water hammer induced by wave action during certain flood stages when pipe was partially submerged.—*R. E. Thompson.*

A New Point in Cold Weather Concreting. C. A. P. TURNER. Eng. News-Rec., 95: 1043–4, 1925. Collapse of John Evans Hotel (cf. Eng. News-Rec., 95: 800) may readily be explained by phenomenon of sweating during rise in temperature of concrete chilled, but not necessarily frozen, during early stages

of curing. Concrete may appear to be very hard, yet will soften and sweat during sharp rise in temperature at some subsequent period 3-5 weeks after casting, hardening later and developing working resistance substantially equivalent to normal concrete. This difficulty may be avoided by placing hot and protecting from chilling for first 2-3 days, which may readily be accomplished by heating mix water. Concrete mixed with water of temperature not exceeding 140–150° F., will, in general, be stronger than concrete mixed with cold water.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Construction Methods on Double-Deck Street, Chicago. Eng. New-Rec., **95**: 662–5, 1925. Quality of concrete was controlled by (1) sand inundation and (2) proportioning by fineness modulus and water-cement ratio. Former, in addition to eliminating uncertainty of employing sand of unknown and varying moisture content, increased rate of hydration of cement and also gave mix that flowed more freely with smaller amt. of water.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Sanitary Control in the Development of Ground Water Supplies. Eng. News-Rec., **95**: 626, 1925. Code of principles formulated by committee of Conference of State Sanitary Engineers and adopted at Louisville, Apr. 25, 1925, is given. Subjects dealt with include suction and gravity piping, collecting and storage reservoirs, cross-connections, wells, well supplies, purification, springs, mine water, and infiltration galleries.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Predetermining Concrete Strength on Park Bridges. W. F. Welsch. Eng. News-Rec., **95**: 630–1, 1925. Details are given of successful application of scientific method of designing concrete mixtures based on researches of Abrams. It was found desirable, as factor of safety, to increase slightly quantity of fine aggregate computed, as slight deficiency results in porous concrete.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Was Gem Lake Dam Disintegration Due to Underburned Cement? Lars Jorgensen. Eng. News-Rec., **95**: 606, 1925. Very heavy white deposit of practically pure $CaCO_3$, noticed on downstream face of Gem Lake Dam prior to failure, which had increased to thickness of ½ inch in places and appeared to continue to increase, cannot be explained by study of water, rock, or sand, and must have been due to decomposition of the cement. Small white deposits often seen on dams originating from leaching out of free lime of cement or of laitance accumulated in construction joints, is harmless and should stop when these materials are all leached out. In this case, action continued, cement itself being affected. Although cement employed conformed to usual tests, it may have been somewhat underburned and on point of instability when exposed to severe low temperatures.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Troubles With Waterweed in Open Shallow Reservoir. E. G. Ritchie. Eng. News-Rec., **95**: 638–9, 1925. Troubles experienced in Melbourne, Aus-

tralia, due to growth of waterweed, *Vallisneria spiralis*, in shallow open reservoir are outlined. Growth at first confined to small area suddenly spread to all parts where water was less than 4–5 feet deep. Extension of area affected was later found due to draining of reservoir in late summer, coincidently with seeding season of the plant. Method of control consists in cutting with submarine weed cutting saw operated from 2 boats.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Water-Cement Theory as a Fact in Field Control of Concrete. JOHN G. AHLERS. Eng. News-Rec., 95: 674–5, 1925. Discussion of cement-water ratio method of concrete control, which is shown to be very satisfactory and practical. Grading of aggregate need only be controlled by workability of mix.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Scale-weighing Device Applies the Water-Cement Ratio Theory. Eng. News-Rec., 95: 675–7, 1925. Mechanical device for controlling water-cement ratio, designed by J. G. AHLERS, is described, together with test methods and results of experiments carried out to show (1) that with constant water-cement ratio, strength of concrete was practically constant with varying amounts of aggregate within workable limits; (2) that with constant water-cement ratio, character of aggregate had little effect on strength of concrete; and (3) that with variable water-cement ratio (illustrated graphically), strength could be controlled as desired.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Well Flow Measured by Pitometer Checked by Orifice. JOHN N. BROOKS Eng. News-Rec., 95: 683–4. Brief details are given of measurement of yield of a well by pitometer and orifice methods, which agreed to within 1.2 per cent. Yield of well was approximately 1000 gallons per minute.—*R. E. Thompson.* (*Courtesy Chem. Absts.*)

Woonsocket, R. I. Eng. News-Rec., 95: 717–8, 1925. Water supply of Woonsocket is derived from tributary of Blackstone River and is chlorinated but not filtered, although subject to turbidity. Improvements are at present under way to increase storage capacity.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Sanitary Rules for Installing Well Pumps. Eng. News-Rec., 95: 706, 1925. Sanitary regulations for installing well pumping machinery are given which were formulated by Committee on Sanitary Control of Ground Water Supplies of Conference of State Sanitary Engineers and approved by a number of pump manufacturers.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Pittsfield Mass. Eng. News-Rec., 95: 793–4, 1925. Water supply of Pittsfield is derived from number of lakes and brooks a few miles from city, and stored in 2 reservoirs of 516 and 450 m.g. capacity. The sanitary sewage is pumped to sand filtration beds about 2 miles from city and surface water drains into branches of Housatonic River.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Concrete Pit Structure Subjected to Diverse Stresses. A. E. WYNN. Eng. News-Rec., 95: 762–3, 1925. Description of construction of waterproof reinforced-concrete structure required to withstand possible external hydraulic pressure. For water-proofing, reliance was placed mainly on quality of concrete, with addition of an integral water-proofing compound. Very dense homogeneous concrete was obtained by use of crushed limestone aggregate with crushed stone dust substituted for sand. Construction joints were reinforced with 20-oz. copper baffle strips bent over on each side of joint. Structure has been in use 5 months and has proved entirely satisfactory.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Water Power and Flood Control of Colorado River Below Green River, Utah. E. C. LA RUE. U. S. Geol. Survey Water Supply Paper 556: 175 pp., 79 plates, 1925. Valuable contribution to momentous question how best to utilize great resources of Colorado River. An important problem is that of reconciling conflicting needs of flood control, power, and irrigation development, because storage and flow requirements of these interests at different times of the year do not coincide. In introduction to report N. C. GROVER writes: "The Geological Survey is not attempting to promote any particular project, but is endeavoring to collect and make available the information needed as the basis for outlining a proper scheme for full development of the river and selecting the site for first development. It recognizes the fact that the final choice of any project will represent a compromise of conflicting interests, in which many factors—engineering, economic, and perhaps political—must be evaluated and given proper weight." Few men, if any, have such first-hand knowledge of problems of development of Colorado as E. C. LA RUE, who since 1914 has travelled practically entire canyon section of river. Report gives data on physical characteristics, plan of development, available water supply, power capacity, right of way, accessibility, and relative value of some 50 dam sites, with photographs, maps, geologic cross sections, and area and capacity curves of most of them. LA RUE presents plan which he believes will "provide for the maximum practicable utilization of the potential power, maximum preservation of water for irrigation, effective elimination of the flood menace, and adequate solution of the silt problem." Plan proposes construction of 13 dams, creating 42,000,000 acre-feet of storage capacity with 3,383 feet of head available for power development by which it is estimated 3,420,000 continuous horsepower may be developed, allowing for full use of water in upper basin. Flood control is considered to be most urgent problem, for property in excess of $100,000,000 is subject to damage by river. For this purpose LA RUE recommends dam in Mohave Canyon near Needles, creating 10,400,000 acre-foot reservoir. Great power development would be in Grand Canyon section with another large storage reservoir of 8,000,000 acre-feet capacity in Glen Canyon above Lees Ferry to regulate flow for power needs. If full use is made of water in upper basin supply will not be enough for all irrigable land in lower basin; and if all irrigable land in Mexico is supplied, about 1,250,000 acres of irrigable land in the United States cannot be watered. Report contains appendix by RAYMOND C. MOORE on geologic features of Grand Canyon, particularly with respect to availability of materials for construction purposes and suitability of rocks at different sites for sustaining dams.—*David G. Thompson.*

NEW BOOKS

The Effects of Ions in Colloidal Systems. MICHAELIS, LEONOR. Baltimore, Md.: Williams & Wilkins Co. Cloth; 5 x 8 in.: pp. 108. $2.50. Reviewed in Eng. News-Rec., 95: 848, 1925.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Bacteriology. THOMAS, STANLEY. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 201. $2.50. Reviewed in Eng. News Rec. 95: 847, 1925.—*R. E. Thompson.* (*Courtesy Chem. Abst.*)

Les Bains à Travers les Âges. PAUL NEGRIER, PIERRE CALMETTES, and M. MARECHALAR, 8vo, 350 pages, Librairie de la Construction moderne, Paris. Noted in Le Genie Civil 87: 240, 1925.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Installer of Pumps. MAURICE LEDOUX, 8vo, 85 pages. Maison Maurice Ledoux et Cie, Bordeaux-Bègles. Noted in Le Genie civil, 87: 28, 1925.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Colloidal State and Industry. W. KOPACZEWSKI. Vol. 1, **The Colloid Industries: historical; the Colloid State; Natural and Artificial Colloids.** 8vo, 328 pages, 36 figs. Cha. Béranger, publisher, Paris, and Liège. Noted in Le Genie civil, 87: 280, 1925.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Lubricants, Their Nature, Examination and Use. GEORGE LEHR. Translated from the German into French by RICHARD ASHER. 250 pages, 17 figs. Ch. Béranger, publisher, Paris and Liège. Noted in Le Genie civil, 87: 200, 1925.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

The Construction of Wells and Boreholes for Water Supply. J. E. DUMBLETON. London, Crosby Lockwood and Sons, 11s. 6d. net 1925. Reviewed in Water and Water Eng., 27: 343-344, 1925.—*Jack J. Hinman, Jr.* (*Courtesy Chem. Abst.*)

Report, Water Supply Commission, Pennsylvania, 1921. Engineers interested in hydrographic data, particularly for Pennsylvania streams, will be pleased to know that the 1921 Report of the Water Supply Commission of Pennsylvania, now available for distribution, contains a precipitation map and tables showing the relation between run-off and precipitation.

This is understood to be the first report of its kind containing such information and subsequent reports issued by the Department of Forests and Waters, Water Resources Service, formerly the Water Supply Commission, will contain similar maps and tables.

The precipitation map shows two inch isohyetals for the year ending September 30, 1921, and tables for each of the primary drainage basins in the State show the drainage area for each gaging station; monthly and yearly run-off in second-feet per square mile; yearly run-off depth in inches; yearly precipitation, depth in inches, and the percentage of run-off to precipitation.

The map used for determining the precipitation upon gaging station drainage areas was especially prepared for the purpose. It is drawn to a scale of about ten miles to the inch, covering the entire State of Pennsylvania and those portions of adjoining states which are tributary to Pennsylvania streams. It shows state and county lines, streams and lines for each degree of latitude and longitude.

All known records of precipitation for Pennsylvania were used, those of the Commission, the United States Weather Bureau and private interests. For drainage areas in adjacent states, tributary to Pennsylvania streams, the Weather Bureau records were used.

The yearly precipitation was plotted at the geodetic position of each of 278 stations. Two inch isohyetals and watershed lines for each gaging station were drawn and the mean precipitation for each drainage area was computed from planimetered areas.

The results are probably as accurate as can be obtained with the number of precipitation stations ordinarily operated. During 1925 the Department of Forests and Waters established several additional stations at localities where there was a sparsity of data.

Reports for the years ending September 30, 1922, and 1923, should be available for distribution in a comparatively short time.—*Ralph H. Hosmer.*